# Four Corners Power Plant

Geohydrology Data Submittal

February 13, 2013

## Introduction

The Arizona Public Service Company Four Corners Power Plant (Plant) is a 2,100 MW coal-fired generating station located in Northwest New Mexico near the town of Fruitland, New Mexico. The Plant is constructed on a mesa located above San Juan and Chaco Rivers. Morgan Lake located just north and east of the Plant provides plant cooling (See Figures 1 and 12). Makeup water is pumped from the San Juan River into Morgan Lake. To control salinity, water is discharged (blown down) from Morgan Lake into a tributary of the Chaco River.

Fly ash and scrubber materials are disposed into lined ash ponds located below and west of the Plant. The Lined Ash Impoundment (LAI) currently receives ash from Units 1-3. Excess ash transport water is drained from the LAI and sent to the Lined Decant Water Pond (LDWP). Dry fly ash from Units 4-5 is disposed to the lined Dry Fly Ash Disposal Area (DFADA). Figure 12 shows the location of these disposal areas.

Historically, ash from Units 1-3 was disposed to Ash Ponds 1-6. These ash ponds are no longer active. The LAI and the LDWP were constructed on top of old Ash Ponds 3 and 4 and part of old Ash Pond 5 in 2003. There are also four old lined evaporation ponds (Evaporation Ponds 1-4) located west of the ash ponds and east of the Chaco River. These evaporation ponds were constructed on top of old Ash Ponds 1 and 2 in 1977. Evaporation Ponds 1-4 received discharge from the groundwater intercept systems until December 2011. The intercept system discharge is now directed to the LDWP.

The information discussed and attached to this submittal is intended to provide the geohydrologic framework for the groundwater movement beneath the ash disposal area located to the west of the generating units. This information was used to develop the design for the intercept trench system described later in the document. Activities and plans related to closure of old Evaporation Ponds 1-4 and the old ash disposal areas are also described.

## Background

The Plant is located near the western margin of the San Juan Basin, a structural depression that lies at the eastern edge of the Colorado Plateau. To the east of the Plant is the Hogback Monocline that forms the eastern edge of the Basin (Stone, et. al. 1983). The monocline dips to the east at about 38º just east of the Chaco River. The dip of the sediments quickly changes to about 3º to 5º to the east beneath the Plant.

The Cliff House Sandstone caps the Hogback to the west of the Chaco River. The Cliff House Sandstone intertongues with the overlying Cretaceous Lewis Shale. The Plant ash ponds are built upon the Lewis Shale, which is a marine shale that contains substantial amounts of evaporite deposits, including gypsum. The Lewis Shale dips about 3º to 5º to the east beneath to the ash ponds. The monitor wells installed around the ash ponds are all completed in the Lewis Shale. Based on the results from the construction of these wells, the Lewis Shale has a weathered zone about 10 – 50 feet deep, normally overlain by a thin layer of soil 1 – 2 feet thick. The weathered zone slopes to the west towards the Chaco River at about 1.2 degrees. The weathered Lewis Shale varies from brown to gray-brown to light gray in color. Beneath the weathered shale the un-weathered Lewis

Shale is gray-brown to blue-gray to dark gray in color. It is significantly less permeable than the weathered shale. The Picture Cliffs Sandstone is located above the Lewis Shale. It is seen in outcrops on top of the mesa where the Plant is located.

Groundwater beneath the ash ponds flows to the west, mainly in the weathered shale and in local alluvial channels that drain towards the Chaco River (Figure 12). There is some uncertainty regarding the contribution of Morgan Lake to the local groundwater. The current groundwater contours suggest that it is a source of water up-gradient of the ash ponds. However, there are three (3) wells that do not fit this interpretation. Wells MW-12R, MW-41 and MW-42 appear to monitor localized perched water zones (see Figure 12). Installation of additional wells located within the ash pond area and between Morgan Lake and the Ash Ponds is planned for later in 2013 to help clarify this issue. The locations for the proposed new wells are shown on Figure 14.

Figures 2 through 11 are geologic cross-sections showing local geology and the location of the piezometric surface of the groundwater in the vicinity of the Plant. Figure 1 shows the location of the cross-sections. Figures 5 through 9 show the geohydrologic conditions from Morgan Lake on the east to the Chaco River on the west. The sections show the groundwater flow direction is east to west at about the same slope as the slope of the interface between the weathered and un-weathered shale. Figure 8 (cross-section G-G') shows the groundwater levels from monitor well LS-1 located east of the ash ponds and to the west towards the Chaco River. Wells LS-1 and LS-2 were drilled as up-gradient wells. Cross-section H-H' in Figure 9 is located just south of section G-G' and shows similar conditions from well LS-2 west towards the Chaco River. However, as discussed above, well MW-12R drilled on the southeastern edge of the LAI (see Figure 12) appears to show a local perched water level.

Figures 2 - 4 show the results of three north-south resistivity surveys conducted west of the ash ponds. These surveys were conducted to assist with the design of intercept trenches intended to capture groundwater moving towards the Chaco River and send it to the LDWP (Figure 12). This impoundment is constructed with a double liner and leachate collection system.

The resistivity data along with geologic information derived from boreholes drilled for the installation of monitor wells showed that the groundwater flow in this area is confined primarily to the un-weathered shale and local alluvial channels. In some cases, water flow was identified in small joint systems within the shale. The most significant flow is within the alluvial channels.

Figures 10 and 11 show cross-sections H-H' and I-I' that give more detail in a deep alluvial zone identified by the resistivity survey and geologic borings and monitor wells. This zone is expected to be the location of greatest groundwater flow in that area.

**Monitor Wells Construction and Location information**

Tables 1 and 2 provide the location and construction information for the monitor wells and extraction wells constructed in the vicinity of the ash ponds. These wells were sampled in the December 2011 and September 2012 sample rounds.

Figure 12 shows the location of the existing monitor wells. Later in 2013, additional monitor wells are planned for construction to replace existing wells that must be abandoned due to activities related to closure of the old Evaporation Ponds 1-4 and the construction of the new South Intercept Trench discussed below. New wells are also planned to provide additional information related to the impact of Morgan Lake on the local groundwater. These wells will be drilled between Morgan Lake and the eastern edge of the ash disposal area and at locations within the ash disposal area between old ash ponds 3, 5 and 6. The data from these wells should better define the gradient and flow direction of the groundwater between Morgan Lake and the ash disposal area. Additional wells are also planned for locations to the south of the ash disposal area to better define the extent and quality of the groundwater in this area. Figure 14 shows the planned location of these new wells and their planned depth.

Exhibit 1 contains copies of the geologic logs for the monitor wells and for geologic borings that provide the basis for the attached geologic cross-sections. The exhibit also contains figures showing the location of these wells and borings.

**Planned Closure of Evaporation Ponds 1-4 and Capping of the Old Ash Disposal Areas**

Construction began in 2012 to close Evaporation Ponds 1-4 and the underlying Ash Ponds 1 and 2. The liners for Evaporation Ponds 1-4 and the evaporites contained in those ponds have been removed and disposed into the lined Phase 1 Dry Fly Ash Disposal Area. Construction is proceeding to re-grade and install an evapotranspiration (ET) cap on top of Ash Ponds 1 and 2. This construction is scheduled for completion in the summer of 2013. The Ash Pond 6 closure project is scheduled to begin construction in the summer of 2013. Ash Pond 6 and those parts of old Ash ponds 3 and 5 not covered by the LAI and LDWP will be re-graded and an ET cap installed. This project is planned for completion by the summer of 2014.

**Intercept Trench Construction and Design**

In 1993, two sets of extraction wells were installed. One set was installed at the northwest corner of Evaporation Ponds 1-4. The second set was installed to the southwest of Evaporation Ponds 1-4. The wells have been in continuous operation since that time. Additional extraction wells were added to the southwestern area in 2011. After review of the well operation and analysis of the geological information, it was determined that a more effective system was needed to provide a continuous barrier to groundwater flow. As discussed above, the groundwater flows in a relatively thin layer of weathered Lewis Shale and in small local alluvial channels that drain towards the Chaco River. The geophysical data along with data gathered by continuous geological cores and test pits also showed the groundwater sometimes flows in thin joint systems within the Lewis shale. The data also show that the Lewis Shale has very low permeability. As a result, it is extremely difficult to install wells that can efficiently capture the groundwater and provide a continuous barrier to flow towards the Chaco River. An intercept trench system on the other hand can be constructed in a way to provide a continuous barrier to trap this groundwater flow.

In 2011, an intercept trench known as the "North Intercept Trench" was installed along the alignment of geologic cross-section Section B-B' (Figure 3). Figure 13 shows the location of the North Intercept Trench and a detailed cross-section of the trench construction. A drainage pipe was set at the bottom of the trench, which is located at the interface between the weathered and un-weathered Lewis Shale. This design allows the drain to capture the groundwater flow in the un-weathered shale and any local alluvial channels intercepted by the trench. Water captured by the drain flows towards sumps where it is collected and pumped to the LDWP. The North Intercept Trench began operation on October 31, 2011.

Figure 13 shows the water levels prior to start of operation (October 2010) and after start of operation (May 2011) in wells located just down gradient of the trench system. After the North Intercept Trench became operational, the groundwater levels were lowered up to 10 feet to a location close to the bottom of the trench and the interface between the un-weathered and weathered Lewis Shale. This demonstrates that the North Intercept Trench is performing as expected and capturing the groundwater flow in the weathered shale.

Construction is planned to start in February 2013 on the South Intercept Trench. The location of this trench is shown on Figure 14 and follows the alignment of geologic cross-section C-C' shown on Figure 4. The South Intercept Trench will connect with the North Intercept Trench, and together, the two trenches are designed to form a complete barrier to groundwater flow to the west towards the Chaco River. The design of the South Intercept Trench is similar to that of the North Intercept Trench. The bottom of the South Intercept Trench will be located at the interface between the un-weathered and weathered Lewis Shale. This trench will be considerably deeper than the North Intercept Trench. The deepest section is expected to be at least 60 feet deep at its deepest point near a local alluvial channel in the vicinity of well MW-38 shown on Figure 4. Construction of the South Intercept Trench should be complete in the early fall of 2013.

## Conclusion

The data provided in this report represent our best evaluation of the geohydrology beneath the site. The data show that the groundwater is primarily moving in the weathered Lewis shale and in local alluvial channels that drain towards the Chaco River. Operational changes at the Plant, closure and capping of old ash disposal areas and construction of new intercept trench systems have reduced and once complete should prevent this migration of groundwater.

In 1993, extraction well systems were installed and began operation. Since 2004, all new fly ash from the Four Corners Units 1-3 has been placed in lined ash impoundments. Since 2007, all new fly ash from Units 4 and 5 has been placed in the lined DFADA. Construction is in progress to close and cap the old ash disposal areas. Installation of the ET cap at Ash Ponds 1 and 2 is scheduled to be completed this summer. Construction is scheduled to begin in the summer of 2013 on the closure of Ash Pond No. 6. It is expected that installation of the ET cap on Ash Pond 6 will be completed by the summer of 2014.

Finally, to provide a continuous barrier to the flow of groundwater towards the Chaco River, the Plant is constructing an intercept trench system located west of the ash impoundments along a north-south alignment (see Figures 13 and 14). The northern portion of this trench system began operation in October 2011. Construction on South Intercept Trench is planned to start in February 2013 and is scheduled to begin operation in the fall of 2013.

After the intercept trench system is complete and the old ash impoundments are closed and capped, we are confident that any further migration of groundwater towards the Chaco River will be contained and prevented.

## References

Stone, W. J.; Lyford, F.P.; Frenzel, P.F.; Mizell, H.H.; and Padgett, E.T., 1983. Hydrology and Water Resources of San Juan Basin, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Hydrologic Report 6, 70p.

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# TABLES

# Table 1 Four Corners Power Plant Monitor Well and Extraction Well Location Data

Survey, May 27, 2012 through June 29, 2012 by Souder, Miller Associates

| Well | Well Type | Northing | Easting | Latitude | Longitude | Ground Surface Elevation | Top of Steel Casing | Top of PVC Casing | Comment |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| DMX-1 | Monitor | 2,071,870.306 | 2,521,916.064 | N36º 41' 30.68488" | W108º 31' 10.22868" | 5096.03 | 5097.19 | 5096.54 | |
| DMX-2 | Monitor | 2,071,078.439 | 2,521,966.704 | N36º 41' 22.85844" | W108º 31' 9.53735" | 5100.04 | 5101.47 | 5100.88 | |
| DMX-3 | Monitor | 2,070,872.970 | 2,521,291.767 | N36º 41' 20.77894" | W108º 31' 17.80601" | 5084.85 | 5086.16 | 5085.5 | |
| DMX-4 | Monitor | 2,068,429.771 | 2,520,848.352 | N36º 40' 56.58897" | W108º 31' 23.03438" | 5072.11 | 5073.53 | 5073 | |
| DMX-5 | Extraction | 2,067,741.201 | 2,521,646.366 | N36º 40' 49.83698" | W108º 31' 13.17688" | 5081.42 | 5083.23 | NM | Active Ext Well - Flange top |
| DMX-6 | Monitor | 2,067,192.477 | 2,521,605.850 | N36º 40' 44.40829" | W108º 31' 13.62602" | 5076.42 | 5077.79 | 5077.4 | |
| EW-1 | Extraction | 2,067,117.671 | 2,521,581.465 | N36º 40' 43.63647" | W108º 31' 13.90389" | 5073.99 | 5074.75 | NM | Active Extraction Well - Flange top |
| EW-10 | Extraction | 2,070,930.509 | 2,521,907.421 | N36º 41' 21.39151" | W108º 31' 10.25222" | 5096.08 | 5096.78 | 5095.91 | Inactive Extraction Well |
| EW-11 | Extraction | 2,071,004.665 | 2,521,925.866 | N36º 41' 22.12608" | W108º 31' 10.03228" | 5099.56 | 5100.16 | NM | Active Extraction Well - Flange top |
| EW-12 | Extraction | 2,071,061.640 | 2,521,957.721 | N36º 41' 22.6917" | W108º 31' 9.64617" | 5100.57 | 5101.39 | NM | Active Extraction Well - Flange top |
| EW-13 | Extraction | 2,071,289.322 | 2,521,956.677 | N36º 41' 24.94295" | W108º 31' 9.67899" | 5098.88 | 5099.17 | 5098.04 | Inactive Extraction Well |
| EW-14 | Extraction | 2,067,703.196 | 2,521,509.638 | N36º 40' 49.4515" | W108º 31' 14.85207" | 5078.85 | 5079.65 | NM | Active Extraction Well - Flange top |
| EW-15 | Extraction | 2,067,874.965 | 2,521,370.949 | N36º 40' 51.14012" | W108º 31' 16.56978" | 5076.82 | 5077.73 | NM | Active Extraction Well - Flange top |
| EW-2 | Extraction | 2,067,178.547 | 2,521,592.389 | N36º 40' 44.2696" | W108º 31' 13.79004" | 5075.9 | 5076.88 | 5075.42 | Inactive Extraction Well - aluminum cap |
| EW-3 | Extraction | 2,067,243.795 | 2,521,601.307 | N36º 40' 44.91541" | W108º 31' 13.68631" | 5082.02 | 5083.03 | 5081.6 | Inactive Extraction Well - aluminum cap |
| EW-4 | Extraction | 2,067,306.571 | 2,521,610.752 | N36º 40' 45.53681" | W108º 31' 13.57588" | 5079.38 | 5081.45 | 5079.07 | Inactive Extraction Well - aluminum cap |
| EW-5 | Extraction | 2,067,369.999 | 2,521,619.875 | N36º 40' 46.13773" | W108º 31' 13.47436" | 5074.93 | 5075.89 | NM | Active Extraction Well - Flange top |
| EW-6 | Extraction | 2,067,427.107 | 2,521,614.397 | N36º 40' 46.70759" | W108º 31' 13.55145" | 5073.24 | 5073.87 | NM | Active Extraction Well - Flange top |
| EW-7 | Extraction | 2,067,489.136 | 2,521,636.632 | N36º 40' 47.34386" | W108º 31' 13.27422" | 5073.74 | 5074.34 | NM | Inactive Extraction Well - Flange top |
| EW-8 | Extraction | 2,067,553.653 | 2,521,646.219 | N36º 40' 47.98249" | W108º 31' 13.1622" | 5077.76 | 5078.41 | 5077.1 | Inactive Extraction Well - aluminum cap |
| EW-9 | Extraction | 2,070,867.932 | 2,521,884.289 | N36º 41' 20.77111" | W108º 31' 10.53073" | 5096.1 | 5096.63 | 5095.39 | Inactive Extraction Well |
| GM-2 | Monitor | 2,068,482.316 | 2,523,534.853 | N36º 40' 57.2983" | W108º 30' 50.05768" | 5125.96 | 5126.32 | 5127.69 | |
| LS-1 | Monitor | 2,069,533.473 | 2,529,315.997 | N36º 41' 8.09203" | W108º 29' 39.17298" | 5368.47 | 5370.57 | 5369.8 | |
| LS-2 | Monitor | 2,068,498.802 | 2,529,315.422 | N36º 40' 57.86105" | W108º 29' 39.09251" | 5397.9 | 5400.16 | 5399.49 | |
| MW-1 | Monitor | 2,070,662.810 | 2,523,914.506 | N36º 41' 18.88579" | W108º 30' 45.58641" | 5138.48 | 5140.43 | 5139.8 | |
| MW-2 | Monitor | 2,070,756.362 | 2,524,362.875 | N36º 41' 19.84222" | W108º 30' 40.0896" | 5148.92 | 5151.03 | 5150.47 | |
| MW-3 | Monitor | 2,071,277.192 | 2,523,713.381 | N36º 41' 24.94674" | W108º 30' 48.10925" | 5125.52 | 5126.98 | 5126.73 | |
| MW-4 | Monitor | 2,072,409.042 | 2,524,302.007 | N36º 41' 36.17976" | W108º 30' 40.98041" | 5148.51 | 5149.66 | 5149.32 | |
| MW-5 | Monitor | 2,070,570.696 | 2,520,764.200 | N36º 41' 17.75254" | W108º 31' 24.25662" | 5087.31 | 5089.3 | 5088.5 | |
| MW-6 | Monitor | 2,068,063.444 | 2,521,470.891 | N36º 40' 53.01091" | W108º 31' 15.35944" | 5080.19 | 5082.71 | NM | Flange Top |
| MW-7 | Monitor | 2,067,347.919 | 2,524,866.308 | N36º 40' 46.1744" | W108º 30' 33.61361" | 5148.29 | 5149.9 | 5149.32 | |
| MW-8 | Monitor | 2,067,581.981 | 2,523,451.559 | N36º 40' 48.38988" | W108º 30' 51.00179" | 5120.85 | 5122.97 | 5122.56 | |
| MW-10 | Monitor | 2,065,094.409 | 2,525,297.908 | N36º 40' 23.92153" | W108º 30' 28.12067" | 5149.65 | 5151.19 | 5150.71 | |
| MW-11 | Monitor | 2,066,102.300 | 2,523,277.542 | N36º 40' 33.74646" | W108º 30' 53.00903" | 5110.48 | 5112.84 | 5111.96 | |
| MW-12R | Monitor | 2,068,365.170 | 2,527,509.566 | N36º 40' 56.41608" | W108º 30' 1.25118" | 5261.71 | 5264.7 | 5264.44 | |

Horizontal Control is State Plan Coordinates New Mexico West Zone, (code 3003) NAD83

Vertical Ortho-metric height computed in NAVD88 using Geoid09 datum.

Note: NM = No Measurement. NA = Not Applicable



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| Well | Well Type | Northing | Easting | Latitude | Longitude | Ground Surface Elevation | Top of Steel Casing | Top of PVC Casing | Comment |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| MW-13 | Monitor | 2,066,528.206 | 2,525,040.922 | N36º 40' 38.08117" | W108º 30' 31.39916" | 5149.52 | 5151.36 | 5150.75 | |
| MW-15 | Monitor | 2,066,785.433 | 2,521,852.445 | N36º 40' 40.40087" | W108º 31' 10.56304" | 5092.28 | 5094.26 | 5093.93 | |
| MW-16 | Monitor | 2,066,347.131 | 2,522,638.010 | N36º 40' 36.12238" | W108º 31' 0.88113" | 5100.42 | 5102.2 | 5101.32 | |
| MW-17 | Monitor | 2,069,573.914 | 2,521,950.173 | N36º 41' 7.98046" | W108º 31' 9.60818" | 5094.38 | 5097.03 | 5096.42 | |
| MW-18 | Monitor | 2,069,694.441 | 2,521,036.433 | N36º 41' 9.10746" | W108º 31' 20.83694" | 5088.06 | 5089.8 | 5089.1 | |
| MW-19 | Monitor | 2,071,286.957 | 2,522,890.880 | N36º 41' 24.9855" | W108º 30' 58.20871" | 5126.34 | 5128.26 | 5127.4 | |
| MW-20 | Monitor | 2,072,202.151 | 2,523,319.355 | N36º 41' 34.06513" | W108º 30' 53.02777" | 5128.59 | 5130.98 | 5130.55 | |
| MW-21 | Monitor | 2,073,087.495 | 2,524,415.484 | N36º 41' 42.89628" | W108º 30' 39.64596" | 5154.47 | 5155.97 | 5155.04 | |
| MW-22 | Monitor | 2,073,074.023 | 2,524,878.134 | N36º 41' 42.79536" | W108º 30' 33.96404" | 5156.3 | 5157.34 | 5156.51 | |
| MW-23 | Monitor | 2,070,718.763 | 2,521,884.608 | N36º 41' 19.29614" | W108º 31' 10.51371" | 5097.04 | 5099.03 | 5098.65 | |
| MW-24 | Monitor | 2,068,062.320 | 2,521,480.455 | N36º 40' 53.00046" | W108º 31' 15.24193" | 5080.41 | 5082.24 | 5081.65 | |
| MW-25 | Monitor | 2,067,567.149 | 2,523,455.085 | N36º 40' 48.24347" | W108º 30' 50.95721" | 5121.79 | 5123.75 | 5122.71 | |
| MW-26 | Monitor | 2,070,666.388 | 2,523,905.003 | N36º 41' 18.92051" | W108º 30' 45.7034" | 5138.36 | 5140.06 | 5139.26 | |
| MW-30 | Monitor | 2,072,222.658 | 2,521,960.648 | N36º 41' 34.17211" | W108º 31' 9.71222" | 5084.38 | 5084.54 | 5084.15 | |
| MW-31 | Monitor | 2,072,695.419 | 2,521,955.295 | N36º 41' 38.8464" | W108º 31' 9.81948" | 5088.47 | 5091.52 | 5091.12 | |
| MW-32 | Monitor | 2,071,643.570 | 2,521,962.678 | N36º 41' 28.4462" | W108º 31' 9.63643" | 5084.94 | 5088.03 | 5087.65 | |
| MW-33 | Monitor | 2,068,867.856 | 2,520,813.547 | N36º 41' 0.91829" | W108º 31' 23.50036" | 5074.26 | 5077.25 | 5076.85 | |
| MW-34 | Extraction | 2,068,099.790 | 2,521,293.156 | N36º 40' 53.35769" | W108º 31' 17.54461" | 5077.34 | 5078.33 | NM | Active Extraction Well - Flange top |
| MW-35 | Monitor | 2,067,229.414 | 2,522,434.520 | N36º 40' 44.83211" | W108º 31' 3.45639" | 5091.81 | 5093.77 | 5093.15 | |
| MW-36 | Monitor | 2,069,951.374 | 2,521,841.331 | N36º 41' 11.7051" | W108º 31' 10.97761" | 5089.61 | 5092.55 | 5092.1 | |
| MW-37 | Monitor | 2,068,287.634 | 2,522,206.115 | N36º 40' 55.27973" | W108º 31' 6.35312" | 5092.49 | 5095.3 | 5094.73 | |
| MW-38 | Monitor | 2,068,081.654 | 2,522,247.142 | N36º 40' 53.24589" | W108º 31' 5.83138" | 5092.38 | 5095.35 | 5094.74 | |
| MW-39 | Monitor | 2,068,277.996 | 2,522,207.807 | N36º 40' 55.18455" | W108º 31' 6.33151" | 5092.73 | 5095.35 | 5094.93 | |
| MW-40 | Monitor | 2,069,609.076 | 2,523,640.187 | N36º 41' 8.44718" | W108º 30' 48.86263" | 5134.91 | 5138.02 | 5137.08 | |
| MW-41 | Monitor | 2,071,279.193 | 2,527,525.246 | N36º 41' 25.23127" | W108º 30' 1.30751" | 5253.98 | 5256.97 | 5256.06 | |
| MW-42 | Monitor | 2,072,910.359 | 2,526,527.600 | N36º 41' 41.29157" | W108º 30' 13.69663" | 5222.32 | 5225.23 | 5224.56 | |
| MW-43 | Monitor | 2,072,045.990 | 2,530,655.841 | N36º 41' 33.02706" | W108º 29' 22.93453" | 5269.42 | 5272.46 | 5271.58 | |
| MW-44 | Monitor | 2,065,826.301 | 2,525,157.767 | N36º 40' 31.14881" | W108º 30' 29.90415" | 5145.15 | 5147.37 | 5146.89 | |
| Piez | Monitor | 2,071,073.019 | 2,521,938.923 | N36º 41' 22.80289" | W108º 31' 9.87797" | 5100.21 | NA | 5101.18 | Located 18 ft W and 8 ft N of EW-12, PVC casing only |
| Piez 5/6 | Monitor | 2,067,399.417 | 2,521,617.417 | N36º 40' 46.45534" | W108º 31' 13.50222" | 5073.59 | NA | 5073.85 | Located btwn EW-5 and EW-6, PVC casing only |
| Well-2 | Monitor | 2,072,953.829 | 2,526,803.337 | N36º 41' 41.74046" | W108º 30' 10.31466" | 5246.06 | 5247.55 | 5247.54 | |

Horizontal Control is State Plan Coordinates New Mexico West Zone, (code 3003) NAD83

Vertical Ortho-metric height computed in NAVD88 using Geoid09 datum.

Note: NM = No Measurement. NA = Not Applicable



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# TABLE 2 Four Corners Power Plant

## Well Construction Data

| Well ID | Installation Date | Casing | Cased Depth of Well (ft bgs) | Screen Interval (feet bgs) | | Screen Length (ft) | Drilled TD (ft bgs) | Installed Pump | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Top of Screen | Bottom of Screen | | | | |
| MW-1 | Sep-87 | 4-inch Sch 80 PVC | 21.6 | 11.6 | 21.6 | 10 | 22 | Bladder pump | |
| MW-2 | Mar-87 | 4-inch Sch 80 PVC | 29.7 | 9.7 | 29.7 | 20 | 30 | Bladder pump | Obstruction at 11.1 ft btoc on 8/31/2010. Not operational |
| MW-3 | Mar-87 | 4-inch Sch 80 PVC | 44.25 | 14.25 | 44.25 | 30 | 80 | Bladder pump | |
| MW-4 | Mar-87 | 4-inch Sch 80 PVC | 35 | 15 | 35 | 20 | 40 | Bladder pump | |
| MW-5 | Mar-87 | 4-inch Sch 80 PVC | 49.1 | 29.1 | 49.1 | 20 | 49.9 | Bladder pump | Transducer |
| MW-6 | Mar-87 | 4-inch Sch 80 PVC | 48.8 | 28.8 | 48.8 | 20 | 50 | Bladder pump | Transducer |
| MW-7 | Mar-87 | 4-inch Sch 80 PVC | 34.7 | 14.7 | 34.7 | 20 | 35 | Bladder pump | |
| MW-8 | Mar-87 | 4-inch Sch 80 PVC | 47.7 | 27.7 | 47.7 | 20 | 50.35 | Bladder pump | |
| MW-9 | Mar-87 | | NA | NA | NA | NA | 20 | NA | Part of Phase I monitor well installation plan. Boring dry. Not completed as a well. |
| MW-10 | Mar-87 | 4-inch Sch 80 PVC | 33 | 13 | 33 | 20 | 35 | None | DRY |
| MW-11 | Mar-87 | 4-inch Sch 80 PVC | 49.9 | 29.9 | 49.9 | 20 | 49.9 | Bladder pump | |
| MW-12 | Sep-87 | 4-inch Sch 80 PVC | 40 | 19.5 | 40 | 20.5 | 40 | NA | Abandoned 5/17/2012 |
| MW-12R | Mar-12 | 5-inch Sch 80 PVC | 33.5 | 13.5 | 33.5 | 20 | 70 | None | |
| MW-13 | Sep-87 | 4-inch Sch 80 PVC | 54.9 | 34.9 | 54.9 | 20 | 54.9 | None | DRY |
| MW-14 | Sep-87 | 4-inch Sch 80 PVC | 39.9 | 19.9 | 39.9 | 20 | 39.9 | NA | Abandoned 5/17/2012 |
| MW-15 | Sep-87 | 4-inch Sch 80 PVC | 52.7 | 22.2 | 52.2 | 30 | 54.1 | Bladder pump | Transducer |
| MW-16 | Sep-87 | 4-inch Sch 80 PVC | 54.8 | 35.5 | 54.8 | 19.3 | 54.8 | Bladder pump | |
| MW-17 | Sep-87 | 4-inch Sch 80 PVC | 24.7 | 4.2 | 24.2 | 20 | 24.7 | Bladder pump | DRY |
| MW-18 | Sep-87 | 4-inch Sch 80 PVC | 55 | 25.5 | 55 | 29.5 | 55 | Bladder pump | Transducer |
| MW-19 | Sep-87 | 4-inch Sch 80 PVC | 49.7 | 29.2 | 49.7 | 20.5 | 49.7 | Bladder pump | |
| MW-20 | Sep-87 | 4-inch Sch 80 PVC | 30 | 9.5 | 30 | 20.5 | 40 | Bladder pump | |
| MW-21 | Sep-87 | 4-inch Sch 80 PVC | 30 | 10.6 | 30 | 19.4 | 30 | Bladder pump | |
| MW-22 | Sep-87 | 4-inch Sch 80 PVC | 30.4 | 10.4 | 30.4 | 20 | 30.4 | Bladder pump | |
| MW-23 | Sep-87 | 4-inch Sch 80 PVC | 49 | 29 | 49 | 20 | 50 | Bladder pump | |
| MW-24 | Sep-87 | 4-inch Sch 80 PVC | 69.7 | 59.7 | 69.7 | 10 | 69.7 | Bladder pump | Transducer |
| MW-25 | Sep-87 | 4-inch Sch 80 PVC | 54.5 | 44.5 | 54.5 | 10 | 54.5 | None | DRY |
| MW-26 | Sep-87 | 4-inch Sch 80 PVC | 50.5 | 40.5 | 50.5 | 10 | 50.5 | None | DRY |
| MW-30[2] | Jun-10 | 5-inch Sch 80 PVC | 26.2 | 16.2 | 26.2 | 10 | 27.2 | None | |
| MW-31 | Jun-10 | 5-inch Sch 80 PVC | 24 | 14 | 24 | 10 | 25 | None | |
| MW-32 | Jun-10 | 5-inch Sch 80 PVC | 20 | 10 | 20 | 10 | 21 | None | |
| MW-33 | Jun-10 | 5-inch Sch 80 PVC | 29 | 14 | 29 | 15 | 50 | None | Transducer |
| MW-34[1] | Jun-10 | 5-inch Sch 80 PVC | 49 | 24 | 49 | 25 | 60 | Grundfos 10 SQ-110 | Extraction Well. |
| MW-35 | Oct-10 | 5-inch Sch 80 PVC | 30 | 20 | 30 | 10 | 80 | None | |
| MW-36 | Oct-10 | 5-inch Sch 80 PVC | 37 | 17 | 37 | 20 | 80 | None | |
| MW-37 | Oct-10 | 5-inch Sch 80 PVC | 58 | 48 | 58 | 10 | 80 | None | |

# TABLE 2 Four Corners Power Plant

## Well Construction Data

| Well ID | Installation Date | Casing | Cased Depth of Well (ft bgs) | Screen Interval (feet bgs) | | Screen Length (ft) | Drilled TD (ft bgs) | Installed Pump | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Top of Screen | Bottom of Screen | | | | |
| MW-38 | Oct-10 | 5-inch Sch 80 PVC | 39 | 14 | 39 | 25 | 60 | None | |
| MW-39 | Oct-10 | 5-inch Sch 80 PVC | 38 | 18 | 38 | 20 | 39 | None | |
| MW-40 | Mar-12 | 5-inch Sch 80 PVC | 22.5 | 12.5 | 22.5 | 10 | 50 | None | |
| MW-41 | Mar-12 | 5-inch Sch 80 PVC | 35.2 | 20.2 | 35.2 | 15 | 50 | None | |
| MW-42 | Mar-12 | 5-inch Sch 80 PVC | 37 | 22 | 37 | 15 | 72 | None | |
| MW-43 | Mar-12 | 5-inch Sch 80 PVC | 26 | 16 | 26 | 10 | 60 | None | |
| MW-44 | Mar-12 | 5-inch Sch 80 PVC | 23.5 | 13.5 | 23.5 | 10 | 40 | None | |
| EW-1 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | Yes | Extraction Well. |
| EW-2 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-3 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-4 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-5 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | Yes | Extraction Well. |
| EW-6 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | Yes | Extraction Well. |
| EW-7 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-8 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well. Transducer installed |
| EW-9 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-10 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-11 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | Yes | Extraction Well. |
| EW-12 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | Yes | Extraction Well. |
| EW-13 | 1993 | 5-inch Sch 40 PVC | ND | ND | ND | ND | | None | Inactive Extraction Well |
| EW-14[1] | Oct-10 | 5-inch Sch 80 PVC | 48 | 18 | 48 | 30 | 49 | Grundfos 10 SQ-110 | Extraction Well. |
| EW-15[1] | Oct-10 | 5-inch Sch 80 PVC | 49 | 19 | 49 | 30 | 50 | Grundfos 10 SQ-110 | Extraction Well. |
| DMX-1 | Apr-92 | 4-inch Sch 40 PVC | 39 | 19 | 39 | 20 | 45 | None | |
| DMX-2 | Apr-92 | 4-inch Sch 40 PVC | 35.5 | 15.5 | 35.5 | 20 | 55 | None | |
| DMX-3 | Apr-92 | 4-inch Sch 40 PVC | 38 | 18 | 38 | 20 | 45 | None | |
| DMX-4 | Apr-92 | 4-inch Sch 40 PVC | 51 | 31 | 51 | 20 | 60 | None | Transducer |
| DMX-5[1] | Apr-92 | 4-inch Sch 40 PVC | 42 | 22 | 42 | 20 | 60 | Grundfos 10 SQ-110 | Extraction Well. |
| DMX-6 | Apr-92 | 4-inch Sch 40 PVC | 35 | 15 | 35 | 20 | 40 | None | Transducer |
| GM-2 | 1974 | 2-inch PVC | ND | ND | ND | ND | 22 | None | TD est. DRY - Bottom well sounded at 23.25 ft btoc. |
| LS-1 | Oct-03 | 4-inch Sch 80 PVC | 359.5 | 329.5 | 359.5 | 30 | 360 | None | Sample with Hydrosleeve |
| LS-2 | Oct-03 | 4-inch Sch 80 PVC | 358 | 328 | 358 | 30 | 360 | None | Sample with Hydrosleeve |
| Well-2 | ND | 2-inch PVC | ND | ND | ND | ND | 194 | None | Drilled TD est based on June 8, 1987 meas. depth to water of 195.65 ft btoc. Sounded dry at 186.2 ft btoc on 8/31/2010 |

# TABLE 2 Four Corners Power Plant

## Well Construction Data

| Well ID | Installation Date | Casing | Cased Depth of Well (ft bgs) | Screen Interval (feet bgs) | | Screen Length (ft) | Drilled TD (ft bgs) | Installed Pump | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Top of Screen | Bottom of Screen | | | | |
| Piez | ND | 2-inch PVC | ND | ND | ND | ND | ND | None | Peizometer measured for water levels by Four Corners Engineering |
| Piez 5/6 | ND | 2-inch PVC | ND | ND | ND | ND | ND | None | Peizometer measured for water levels by Four Corners Engineering |

**Notes**

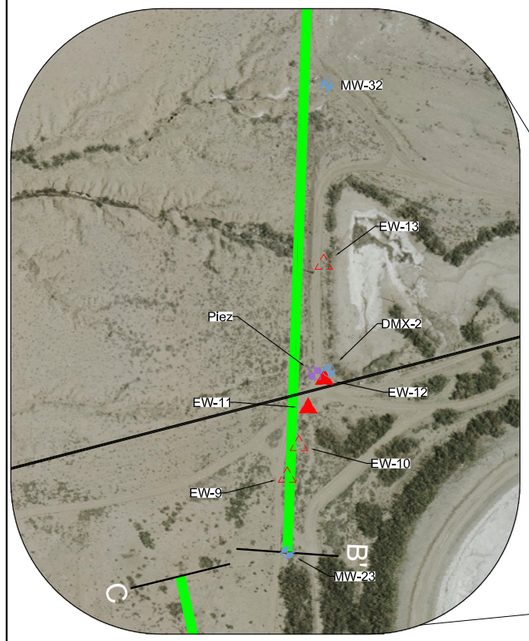
NA = Not Applicable
ND = No Data
ft bgs = feet below ground surface
ft btoc = feet below top of PVC casing

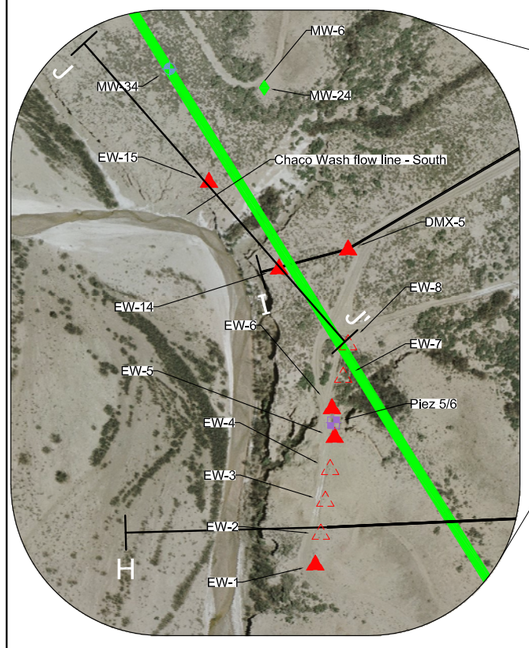
ft bgs = feet below ground surface
ft btoc = feet below top of PVC casing
NS - Not surveyed
ND - No Data

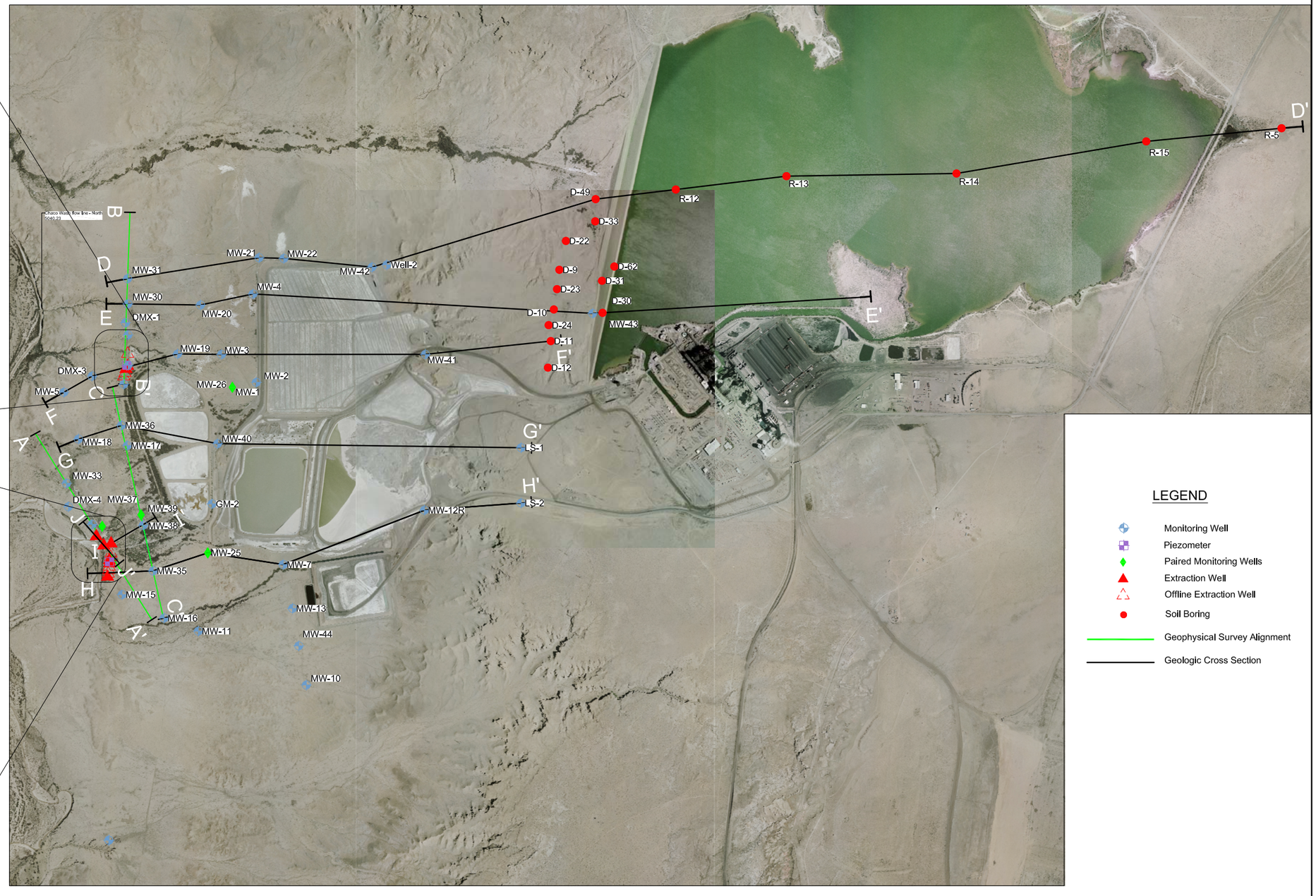
[1] Active Extraction Well. Top of PVC not surveyed. Measure point is top of steel flange.

[2] MW-30: Original grade was backfilled due to construction of trench. Top of steel was 3.39 feet above ground surface and PVC was 2.95 feet above ground surface. Therefore old surface elevation was approximately 5018.2 ft. rounded to nearest 0.1 ft (Top Steel elev of 5084.54- 3.39ft) Based on old ground elevation, TD= 24ft bgs, Depth cased = 23ft bgs, top screen = 13ft bgs and bottom screen = 23 ft bgs.

# FIGURES




## LEGEND

- Monitoring Well
- Piezometer
- Paired Monitoring Wells
- Extraction Well
- Offline Extraction Well
- Soil Boring
- Geophysical Survey Alignment
- Geologic Cross Section

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, NAD83, WEST ZONE, US SURVEY FOOT,

TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979

N

HORIZONTAL 0 1000 2000

SCALE IN FEET

# Geological Cross Section Index

## Arizona Public Service
## Four Corners Power Plant

Figure 1

URS

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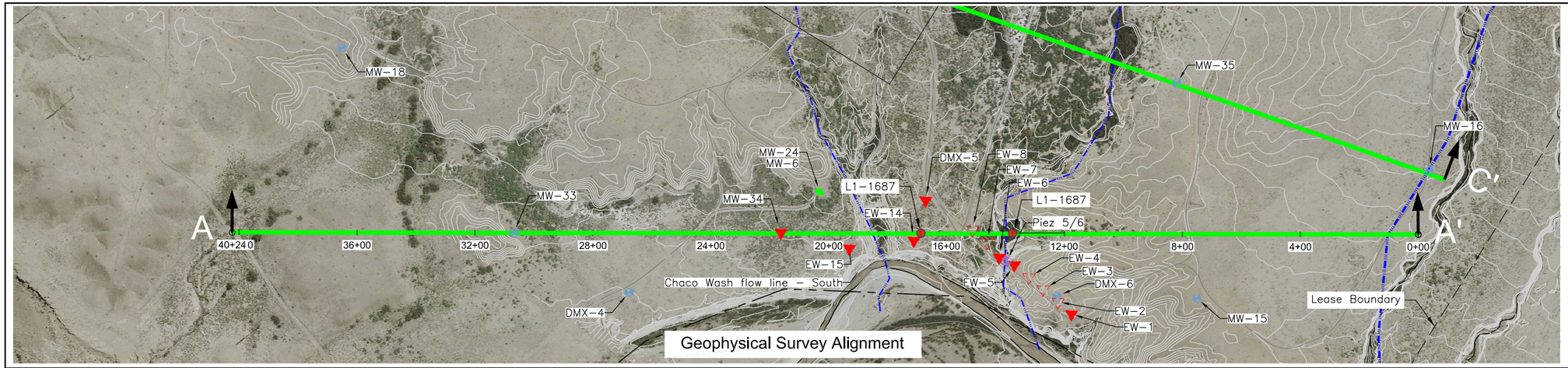
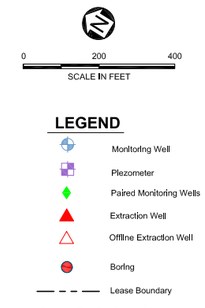



**MW-33 Lithology**

0-6 Lean clay. Light brown, medium plasticity, very soft, loose, dry
6-8 Gravelly lean clay. Light brown, gravel is subrounded, clay has medium plasticity, very soft, loose.
8-30 Weathered shale. Brown, weak to moderate cementation, dry to moist, gypsum, and iron staining present
15-17 Moist
18-21 Wet, clay present, no gypsum
21-22 Moist
22-25 Wet, play present, no gypsum
25-30 Moist
30-50 Unweathered Shale. Blue gray, moderate to strong cementation, dry to moist, reacts with HCl

**MW-34 Lithology**

0-4.5 Lean clay. Brown, medium plasticity, moist
4.5-5 Poorly graded sand. Fine to medium grained, moist
5-10 Weathered shale. Brown, weak to moderate cementation, iron staining and gypsum present, moist
10-13 Wet, mostly clay with iron staining
13-14 1/16 inch thick layer of gypsum, moist
14-17 Wet, mostly clay with iron staining
17-21 moist
18.8 1 inch thick layer of wet shale
21-50 Unweathered shale. Blue-gray, moderate to strong cementation, moist to dry, calcite present in small amounts, reacts with HCl

**Extraction well EW-15 Lithology**

0-9 Sandy lean clay. Brown medium plasticity, medium toughness, moist.
9-17 Lean Clay. Dark brown, medium plasticity, medium toughness, moist
17-19 Sandy lean clay. Medium plasticity, medium toughness, moist
19-23 Lean clay. Medium plasticity, medium toughness, wet
23-25 Clayey Sand. Fine to medium grained, wet
25-36 Lean clay. Medium plasticity, medium toughness, wet
36-47 Sand. Poorly graded, fine to medium grained, wet
47-50 Lean clay. Brown and black, wet

**Extraction well EW-14 Lithology**

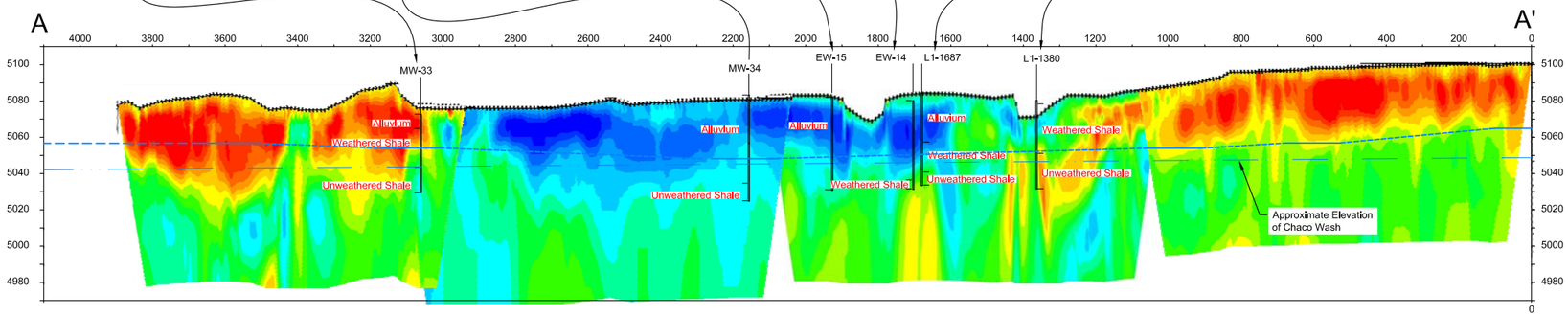
0-12 Clayey Sand. Brown, fine to medium grained. Moist (7-12 loose)
12-25 Lean clay with sand. Brown, medium pl
20-25 Wet
25-39 Sandy lean clay. Medium plasticity, Medium toughness, wet
39-43 Sand. Brown, poorly graded, fine to Medium grained, wet
43-49 Weathered Shale. Brown, fractured, iron staining, moist

**L1-1687 Lithology**

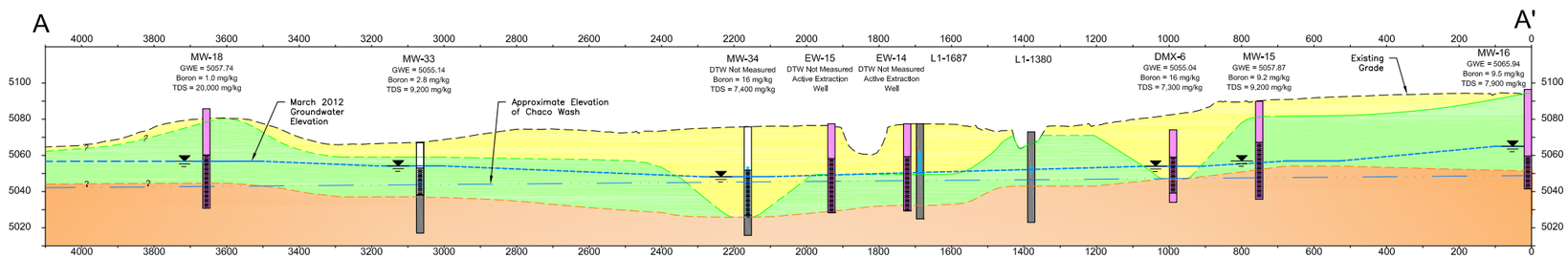
0-28 Lean clay. Brown, medium plasticity, very stiff, dry to moist
12 Moist, soft to medium stiffness
15-26 Wet, soft to very soft
26-27 West, stiff
28-45 Weathered shale. Brown, weak to moderate cementation, iron staining and trace gypsum, moist
45-52.2 Unweathered Shale. Blue/gray, moderate to strong cementation, reacts with HCl, dry to moist

**L1-1380 Lithology**

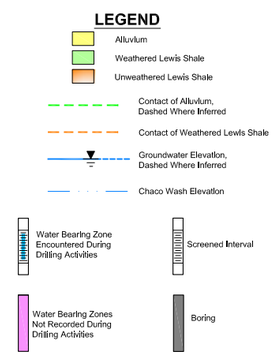
0-2 Lean clay. Light brown, medium plasticity, dry, unweathered shale fragments present
2-30 Weathered Shale. Brown, weak to moderate cementation,iron staining and gypsum present, dry to moist
15-19 Moist
19-23 Wet clay, no gypsum
23-30 Moist, iron staining and gypsum present
30-50 Unweathered Shale. Blue/gray, moderate to strong cementation, dry, reacts with HCl.




Resistivity Cross-Section Data




Geologic Cross-Section




REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, NAD83, WEST ZONE, US SURVEY FOOT.

TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979

HORIZONTAL 0 200 400 SCALE IN FEET

VERTICAL 0 40 80 SCALE IN FEET

URS

# Geophysical Survey Line and Well Locations

Arizona Public Service
Four Corners Power Plant
Figure 2

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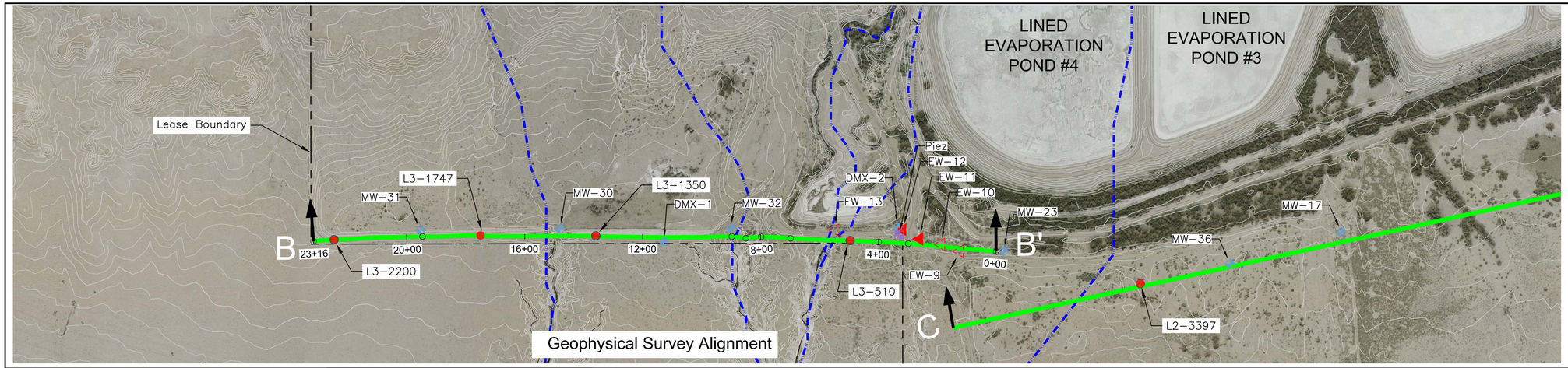



0 200 400
SCALE IN FEET

## LEGEND

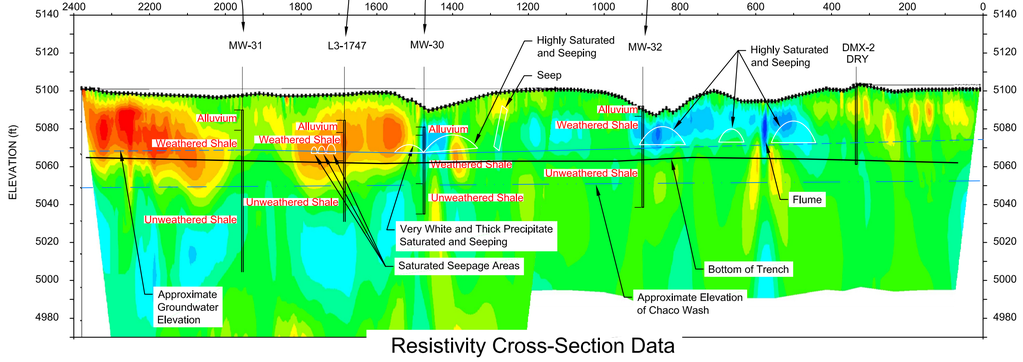
- Monitoring Well
- Piezometer
- Paired Monitoring Wells
- Extraction Well
- Offline Extraction Well
- Boring
- Lease Boundary
- Historic Wash

**MW-31 Lithology**
0-10 Silty Sand. Light brown, mostly fine grained, weakly cemented, moist
10-25 Weathered Shale. Brown, weathered, weak to moderate cementation, iron staing, gypsum present, moist
15-16 Weak cementation, trace gypsum, abundant clay content, moist to wet
16-17 Vertical cracks in clay, wet
17-25 Weak to moderate cementation, increased iron staing and gypsum content, horizontal sheets of weathered shale 1/8 to ½ inch thick. Vertical crack noted in core ½ inch thick at 22.5 feet
25-80 Unweathered Shale. Blue/gray, moderate to strong cementation, shale broken into 1/8 inch to ½ inch thick flat fragments, reacts with HCl, moist
44 Moist to wet 1 inch thick layer of unweathered shale containing clay
47 Moist to wet 1 inch thick layer of unweathered shale with abundant clay content
65 1 inch thick layer of moist to wet unweathered shale with abundant clay content

**L3-1747 Lithology**
0-6 Lean clay. Light brown, medium plasticity, dry to moist, trace amounts of gypsum
6-20 Weathered Shale. Brown, weak to moderate cementation, iron staining and gypsum present, moist. 1 inch thick layer at 16 feet wet with visible water, otherwise moist. ½ inch thick layer at 19 feet wet with visible water, otherwise moist.
20-50 Unweathered Shale. Blue/gray, moderate to strong cementation, dry, gypsum noted at 20-20.5, Reacts with HCl at 28.
30-31 Moist
31-32 Dry
32 1 inch thick layer of wet unweathered shale, otherwise dry

**MW-30 Lithology**
0-3.5 Lean clay. Brown, medium plasticity, medium stiff, moist
3.5-4 Clayey sand with gravel. Brown, mostly coarse sand, fine to coarse gravel, sub-rounded to sub-angular, moist
4-24 Weathered Shale. Brown with red and white staining, weakly cemented, iron staining, very little gypsum crystals
6-15 Brown weak to moderate cementation, iron staining, little but increasing amount of gypsum crystals
15-16 Brown, high clay content, wet and visible water in clay layers, no iron staining or gypsum visible
16-24 Brown with moderate cementation, some iron staining and gypsum present, black and brown laminations present
24-43 Unweathered Shale. Blue/gray, contains very fine grained sand, black and blue/gray layers, moderate to strong cementation, dry, reacts with HCl.

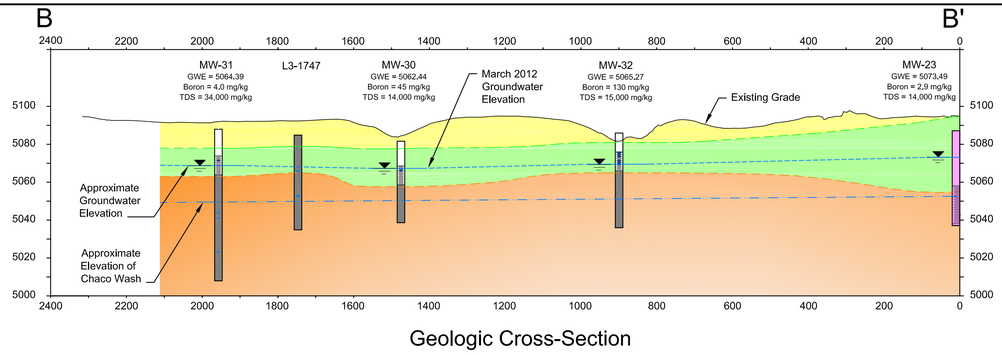
**MW-32 Lithology**
0-4.5 Lean Clay. Brown, medium plasticity, moist
4.5-5 Poorly graded sand. Fine to medium grained, moist
5-21 Weathered shale. Brown, weak to moderate cementation, iron staining and gypsum present, moist
10-13 Wet, mostly clay with iron staining
13-14 1/16 in thick layer of gypsum, moist
14-17 Wet, mostly clay with iron staining
17-21 Moist. 1 inch thick layer of wet shale at 18.8
21-50 Unweathered shale. Blue/gray, moderate to strong cementation, moist to dry, calcite present in small amounts, reacts with HCl




Resistivity Cross-Section Data

Resistivity — Conductivity

Ohm-m
150 High → Low
47,4
15,0
4,7
1,5 Low → High




Geologic Cross-Section

## LEGEND

- Alluvium
- Weathered Lewis Shale
- Unweathered Lewis Shale
- Contact of Alluvium, Dashed Where Inferred
- Contact of Weathered Lewis Shale
- Groundwater Elevation, Dashed Where Inferred
- Chaco Wash Elevation
- Water Bearing Zone Encountered During Drilling Activities
- Screened Interval
- Wells Installed In 1987 Water Bearing Zones Not Recorded During Drilling Activities
- Boring

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, NAD83, WEST ZONE, US SURVEY FOOT.

TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979

HORIZONTAL 0 200 400 SCALE IN FEET

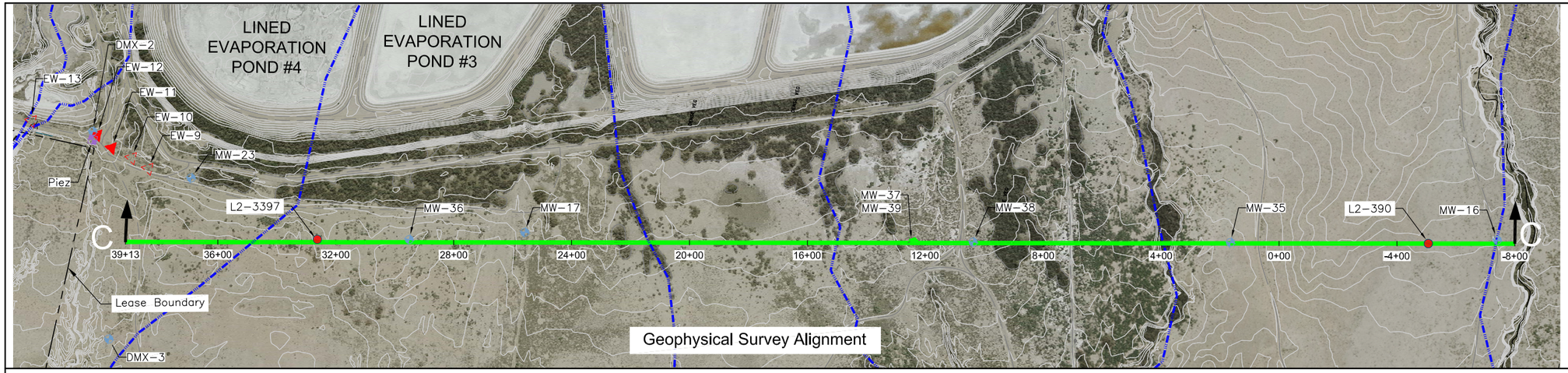
VERTICAL 0 40 80 SCALE IN FEET

NOTE: L3-1532, L3-1747, L3-1957 DRILLED IN BORROW PIT DIRECTLY EAST OF LINE 3, AT LOWER SURFACE ELEVATION.

URS

# Geophysical Survey Line and Well Locations
Arizona Public Service
Four Corners Power Plant
Figure 3

P:\WRES\Arizona_Public_Service\23446329_APS_FCPP_Wells_&_Geology\5_0_Technical\5_6_CADD\Figures\ A20177.dwg




**MW-23 Lithology**
0-5 Shale. Light brown, heavily weathered, silty and clayey
5-10 As above. Very slight matrix moisture
10-12.5 As above. Damp
12.5-15.0 Brown coarse sand and pebbles, with abundant clay. Damp
15-18.5 As above
18.5-20 Shale. Brown, heavily weathered
20-35 As Above. Damp
35-40 Shale. Brown to gray brown, moderately weathered and silty
40.5 Top of unweathered shale
40-45 Shale. Blue-gray, slight to unweathered, dry to damp.
45-50 Shale. Blue-gray, unweathered.

**MW-33 Lithology**
0-16 Lean clay with sand, moist
16-17 Clayey sand, wet
17-36 Weathered shale, moist
17-27 moist
27-34 moist, wet in facture zones
30-34 gypsum present
34-36 moist
36-60 Unweathered shale
40-60 fractured, dry

**MW-36 Lithology**
0-4 Sandy lean clay, moist
4-6 Poorly-graded sand, moist
6-8 Weathered shale, moist
8-9 Poorly-graded sand, moist
9-35 Weathered shale
15-27 Clay and water observed in fractures
37-35 Weathered shale, wet (with clay) in fractures
35-39 Unweathered shale, dry
37-38 Unweathered shale, wet, with some clay in fractures
39-80 Unweathered shale, dry (moist at top of core sections
- most likely due to water in borehole.

**MW-17 Lithology**
0-5 Alluvium. Light brown, silty to fine grained sand, large percentage of clay
5-10 Silty shale. Brown, fine-grained sand to silt, large percentage of clay. Wet. Moisture at 6 feet
10-15 As above. Sample moist
15-20 As above. Mostly clay. Sample muddy.
20-30 As above. Sample muddy
30-35 More competent. Heavily weathered, brown, large percent clay. Sample muddy.
35-40 Shale. Brown to gray/brown, moderate to slight weathering, silt and fine-grained sandstone. Sample muddy
40-45 As above. Sample muddy
47 Top of unweathered shale
45-50 Shale. Blue/gray, unweathered, with fragments of orange sandstone and buff petrified wood. 60% Sandstone fragments
50-55 As above. Even mix of shale and sandstone fragments.
55-60 As above. 60% shale fragments

**MW-37 Lithology**
0-8 Sandy lean clay, moist
8-36 Weathered shale with clay and fractures, moist
18-20 Clay with weathered shale, wet
20-30 wet in fractures
30-36 wet in fractures
36-80 Unweathered shale
36-48 dry
48-58 wet in fractures
58-60 dry
60-61 fractured with clay, wet
61-71 dry, hard rock
71-80 several 1-inch to 3-inch fractures with water observed

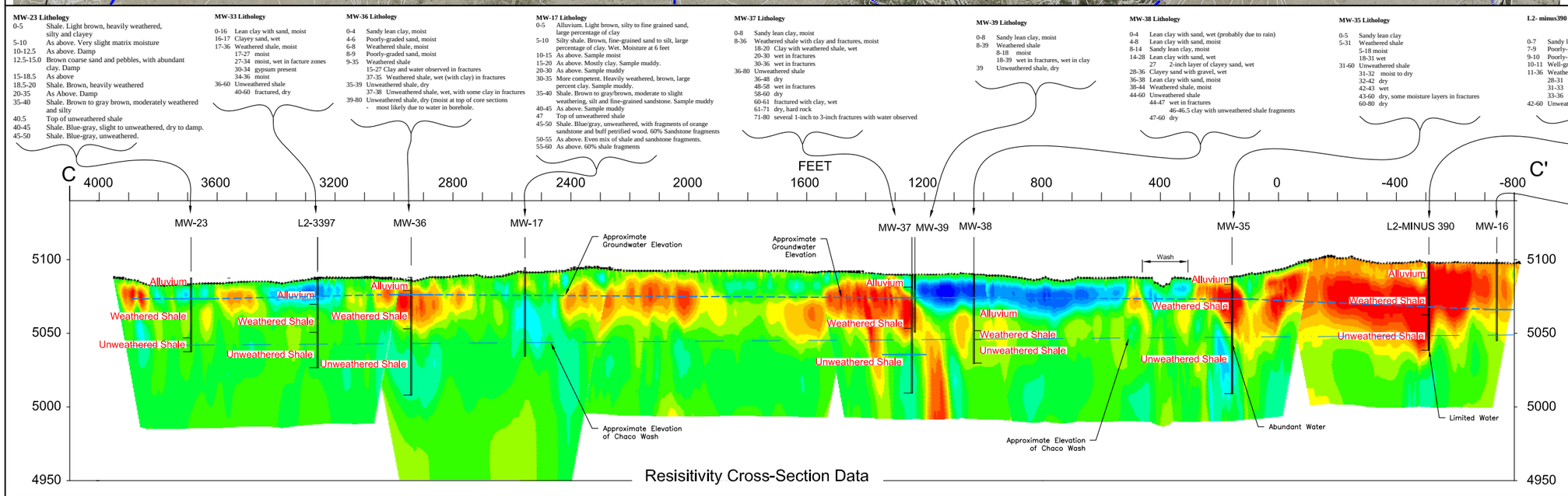
**MW-39 Lithology**
0-8 Sandy lean clay, moist
8-39 Weathered shale
8-18 moist
18-39 wet in fractures, wet in clay
39 Unweathered shale, dry

**MW-38 Lithology**
0-4 Lean clay with sand, wet (probably due to rain)
4-8 Lean clay with sand, moist
8-14 Sandy lean clay, moist
14-28 Lean clay with sand, wet
27 2-inch layer of clayey sand, wet
28-36 Clayey sand with gravel, wet
36-38 Lean clay with sand, moist
38-44 Weathered shale, moist
44-60 Unweathered shale
44-47 wet in fractures
46-46.5 clay with unweathered shale fragments
47-60 dry

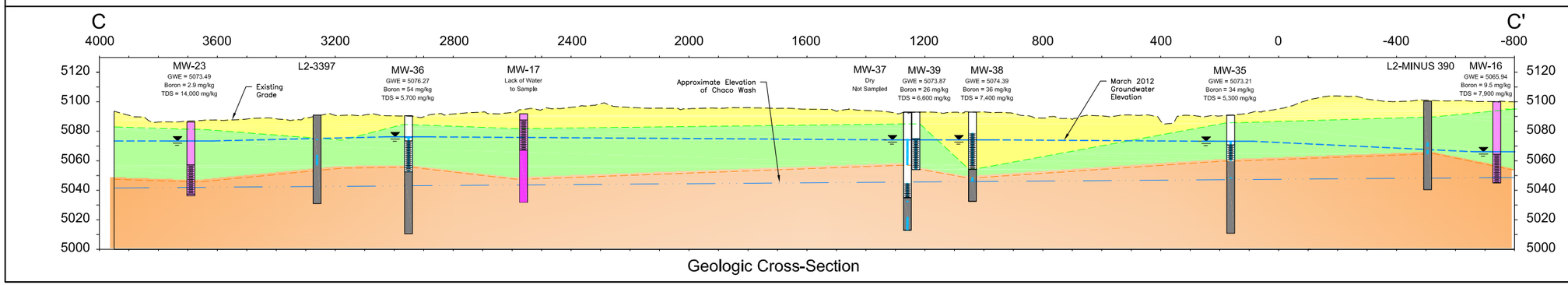
**MW-35 Lithology**
0-5 Sandy lean clay
5-31 Weathered shale
5-18 moist
18-31 wet
31-60 Unweathered shale
31-32 moist to dry
32-42 dry
42-43 wet
43-60 dry, some moisture layers in fractures
60-80 dry

**L2- minus390 Lithology**
0-7 Sandy lean clay
7-9 Poorly-graded sand with clay
9-10 Poorly-graded sand with gravel
10-11 Well-graded sand with gravel
11-36 Weathered shale
28-31 visible water in fractured shale
31-33 moist shale
33-36 visible water in fractured shale
42-60 Unweathered shale dry

**MW-16 Lithology**
0-15 Shale. Heavily weathered, light brown, fine grained, silty and clayey
15-20 Shale. Heavily weathered, brown, with fine-grained sand and large percent of clay. Moist
20-25 Shale. Light gray brown, moderately weathered, silty, clayey
25-30 Shale. Brown, heavily weathered, silty, mostly clay.
30-35 As above. Gypsum fragments present
35-45 As above. No gypsum
45-46 Shale. Heavily weathered, dark brown-grey, silty. Moist
46 Top of unweathered shale
46-50 Shale. Very slight to unweathered, blue-gray and silty
50-55 As above. Unweathered




Resisitivity Cross-Section Data




Geologic Cross-Section

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, NAD83, WEST ZONE, US SURVEY FOOT.

TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NOVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979

HORIZONTAL 0 200 400 SCALE IN FEET

VERTICAL 0 40 80 SCALE IN FEET

NOTE: WELLS MW-16, MW-17, AND MW-23 HAVE BEEN PROJECTED ONTO SECTION C-C'
L2-MINUS 390 AND L2-3397 INCLUDED FOR LITHOLOGY ONLY.,
GROUNDWATER ELEVATION BASED ON MARCH 2012 SURVEY
CHACO WASH ELEVATION BASED ON 2012 SURVEY
WATER QUALITY DATA FROM DECEMBER, 2011

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# Geophysical Survey Line and Well Locations
Arizona Public Service
Four Corners Power Plant
Figure 4

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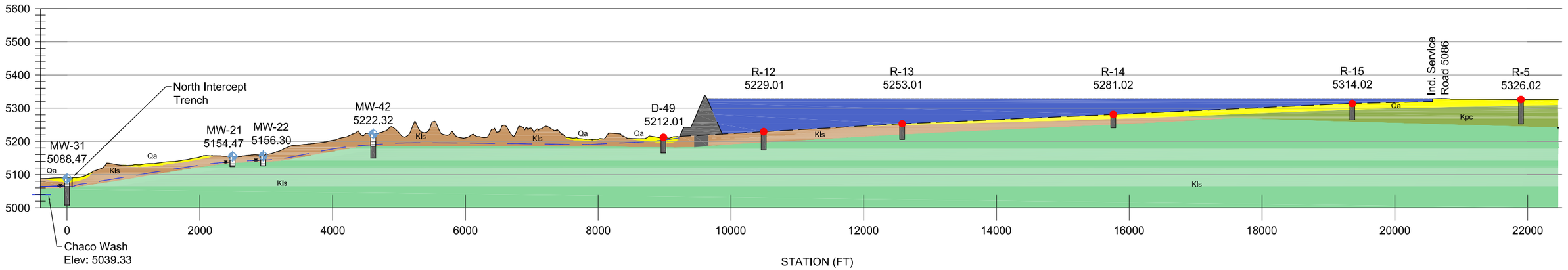
# SECTION D-D'




LEGEND

| | |
|---|---|
| Monitoring Well | March 2012 Groundwater elevation (Solid where known, dashed where inferred) |
| Soil Boring | 2010 Surface Topography (Dashed where inferred) |
| Well and Screen | Surface Water Elevation |
| Boring | |
| MW-31 5088.47 | Name Surface Elevation |

| | |
|---|---|
| | Morgan Lake Dam |
| | Morgan Lake |
| Qa | Alluvium |
| Kpc | Pictured Cliffs Sandstone |
| Kls | Weathered Lewis Shale |
| Kls | Unweathered Lewis Shale |
| Kls-LS | Limestone |

HORIZONTAL: 0 1500 3000

VERTICAL: 0 300 600

SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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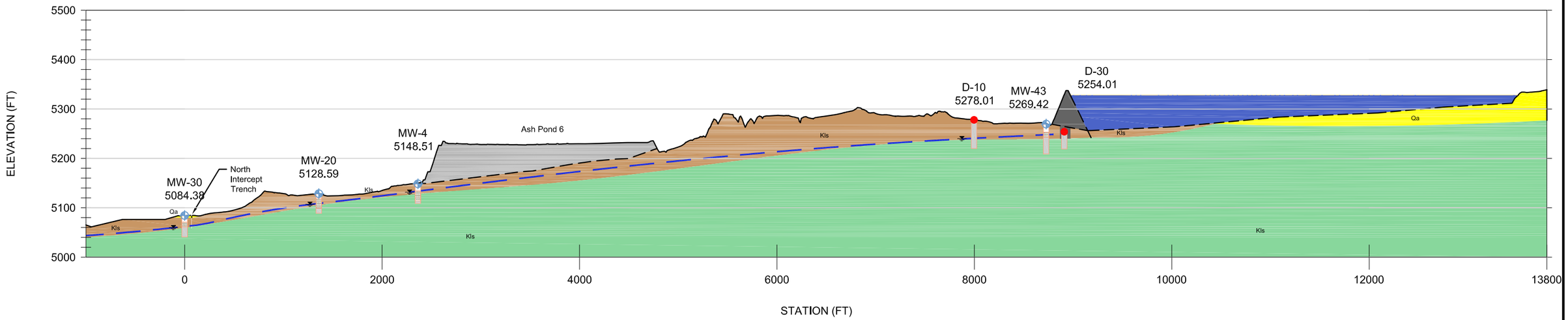
# Geologic Cross Section D-D'

Arizona Public Service

Four Corners Power Plant

Figure 5

# SECTION E-E'




LEGEND

- Monitoring Well
- Soil Boring
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)
- Surface Water Elevation
- Ash
- Morgan Lake Dam
- Morgan Lake
- Qa — Alluvium
- Kpc — Pictured Cliffs Sandstone
- Kls — Weathered Lewis Shale
- Kls — Unweathered Lewis Shale

N

HORIZONTAL: 0 1000 2000

VERTICAL: 0 200 400

SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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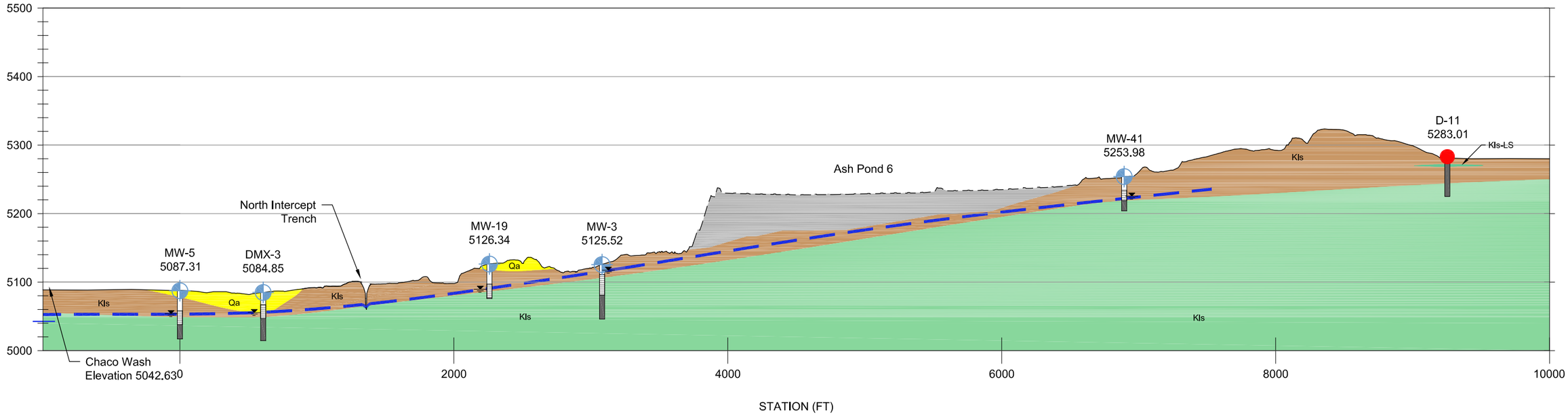
# Geologic Cross Section E-E'

Arizona Public Service

Four Corners Power Plant

Figure 6

# SECTION F-F'




LEGEND

- Monitoring Well
- Soil Boring
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)
- Ash
- Qa — Alluvium
- Kpc — Pictured Cliffs Sandstone
- Kls — Weathered Lewis Shale
- Kls — Unweathered Lewis Shale
- Kls-LS — Limestone

HORIZONTAL: 0 750 1500
VERTICAL: 0 150 300
SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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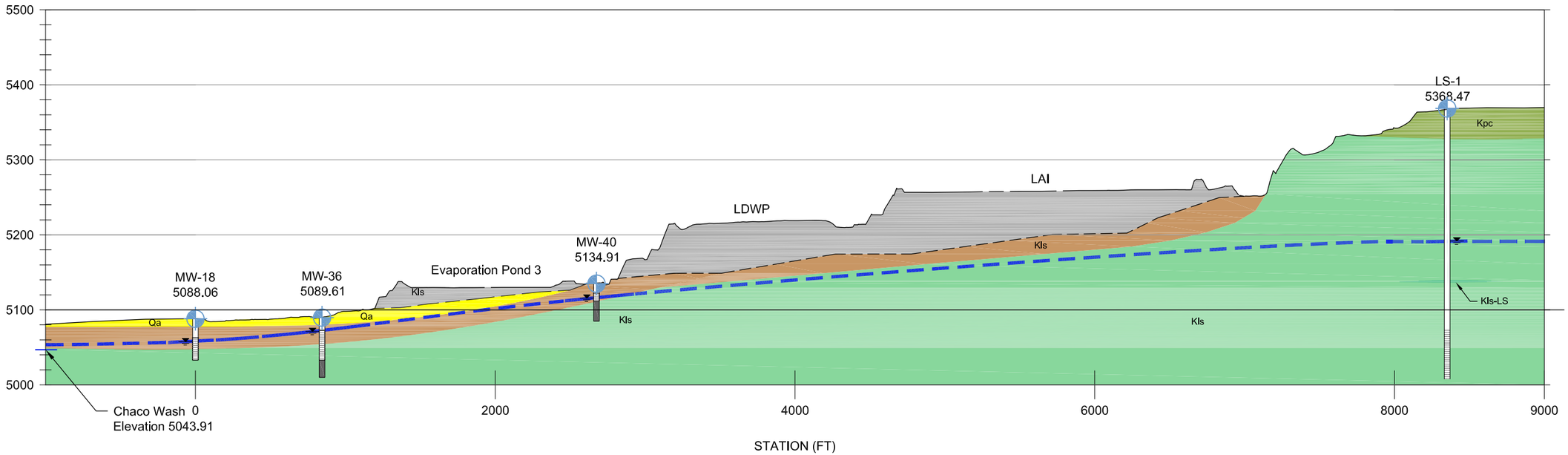
## Geologic Cross Section F-F'

Arizona Public Service
Four Corners Power Plant

Figure 7

# SECTION G-G'




LEGEND

- Monitoring Well
- Soil Boring
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)
- Ash
- Qa — Alluvium
- Kpc — Pictured Cliffs Sandstone
- Kls — Weathered Lewis Shale
- Kls — Unweathered Lewis Shale
- Kls-LS — Limestone

HORIZONTAL: 0 750 1500
VERTICAL: 0 150 300
SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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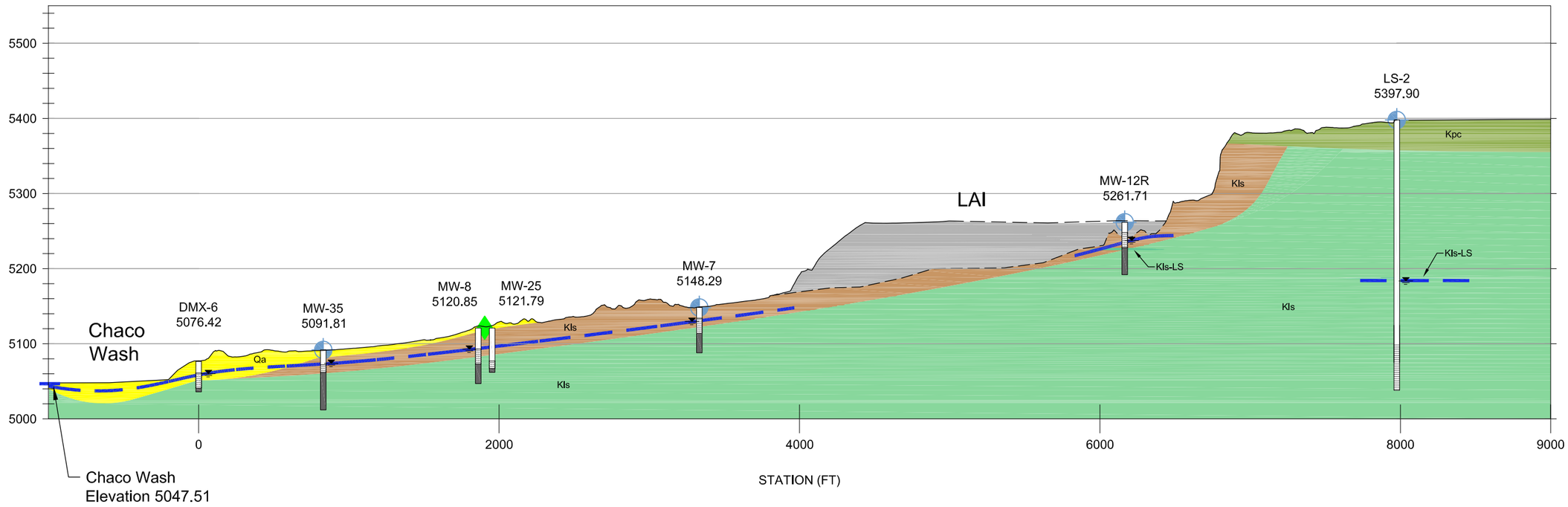
## Geologic Cross Section G-G'

Arizona Public Service
Four Corners Power Plant

Figure 8

# SECTION H-H'




LEGEND

- Monitoring Well
- Paired Monitoring Well
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)
- Ash
- Qa — Alluvium
- Kpc — Pictured Cliffs Sandstone
- Kls — Weathered Lewis Shale
- Kls — Unweathered Lewis Shale
- Kls-LS — Limestone

HORIZONTAL: 0 750 1500
VERTICAL: 0 150 300
SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979, WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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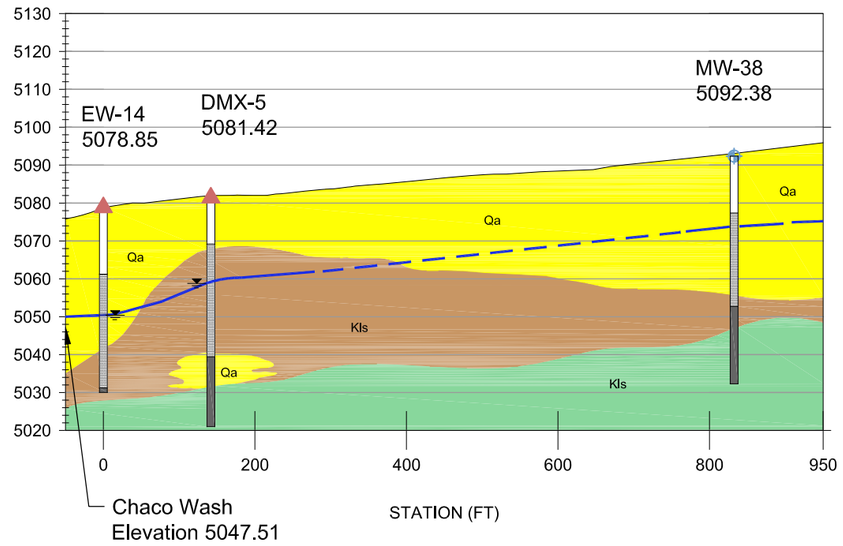
## Geologic Cross Section H-H'

Arizona Public Service
Four Corners Power Plant

Figure 9

# SECTION I-I'




LEGEND

- Monitoring Well
- Extraction Well
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)

| | |
|---|---|
| Qa | Alluvium |
| Kpc | Pictured Cliffs Sandstone |
| Kls | Weathered Lewis Shale |
| Kls | Unweathered Lewis Shale |
| Kls-LS | Limestone |

HORIZONTAL: 0 200 400

VERTICAL: 0 40 80

SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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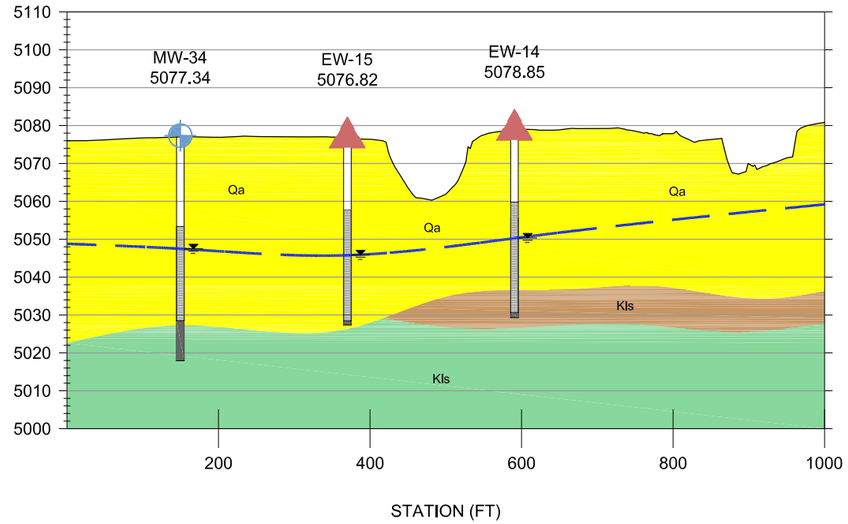
## GEOLOGIC CROSS SECTION I-I'

Arizona Public Service
Four Corners Power Plant

Figure 10

# SECTION J-J'




LEGEND

- Monitoring Well
- Extraction Well
- Well and Screen
- Boring
- MW-31 / 5088.47 — Name / Surface Elevation
- March 2012 Groundwater elevation (Solid where known, dashed where inferred)
- 2010 Surface Topography (Dashed where inferred)
- Ash
- Qa — Alluvium
- Kpc — Pictured Cliffs Sandstone
- Kls — Weathered Lewis Shale
- Kls — Unweathered Lewis Shale
- Kls-LS — Limestone

HORIZONTAL: 0 200 400
VERTICAL: 0 40 80
SCALE IN FEET

REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD83/NAVD88, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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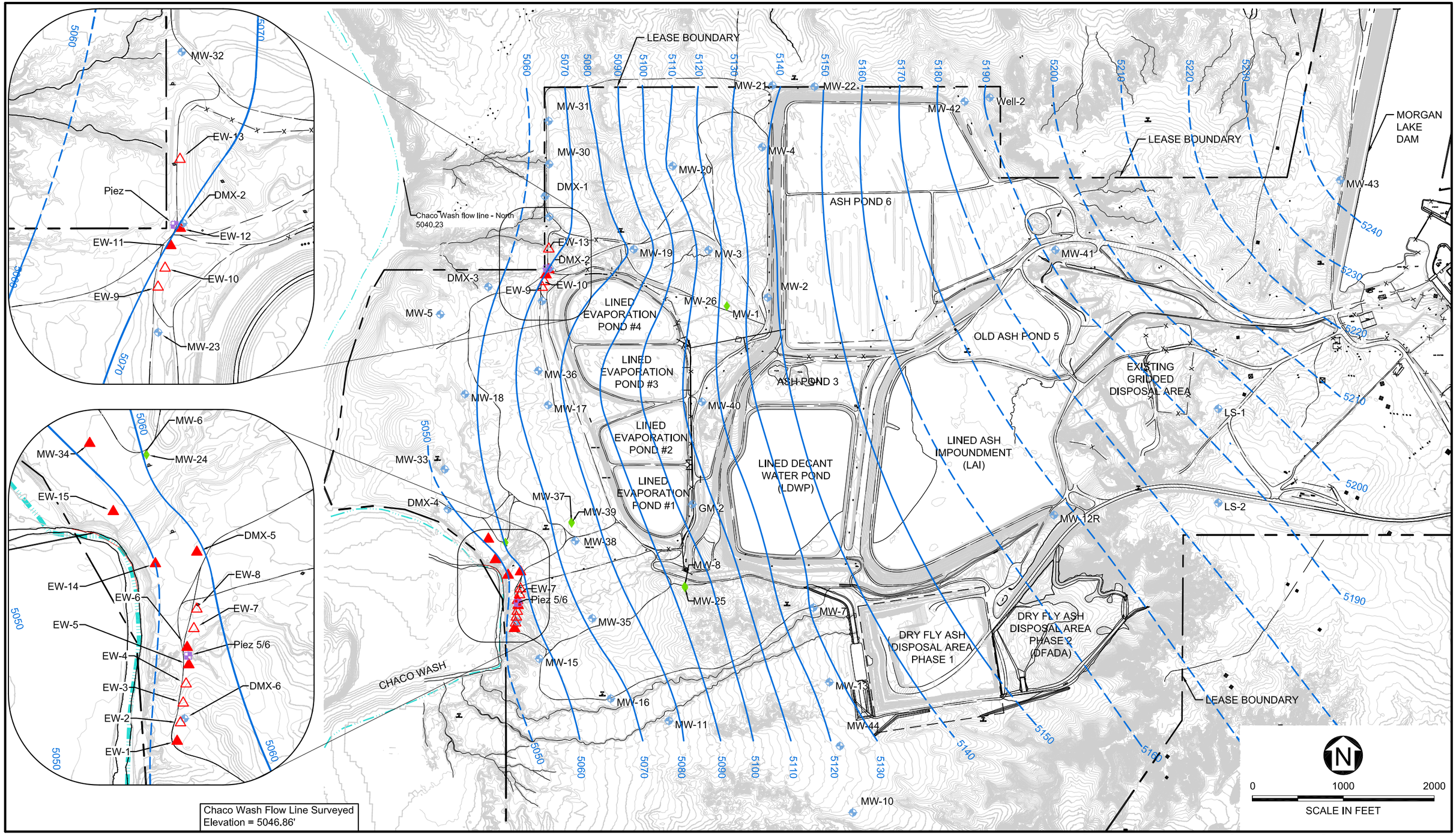
## Geologic Cross Section J-J'
Arizona Public Service
Four Corners Power Plant

Figure 11




REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

LEGEND

- Monitoring Well
- Piezometer
- Paired Monitoring Wells
- Extraction Well
- Offline Extraction Well
- Chaco Wash
- 5140 Groundwater Contour (Dashed where inferred)

GWE Groundwater Elevation
DTW Depth To Water (in feet below top of casing)
NC Wells Not Used For Contouring

(Data collected on 02/22/12)
(MW-12R, MW-40 through MW-44 Data Collected 03/29/12)

# March 2012 Groundwater Elevation Contour Map

## Arizona Public Service

## Four Corners Power Plant

Figure 12

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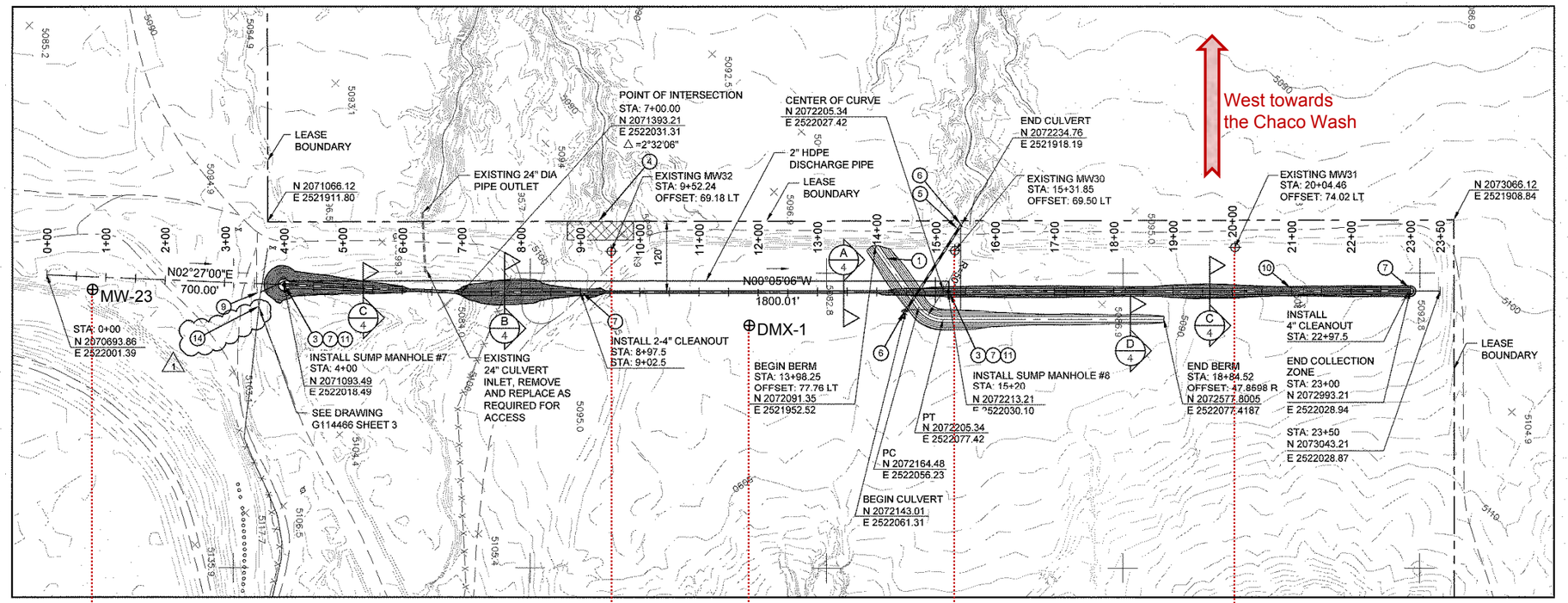
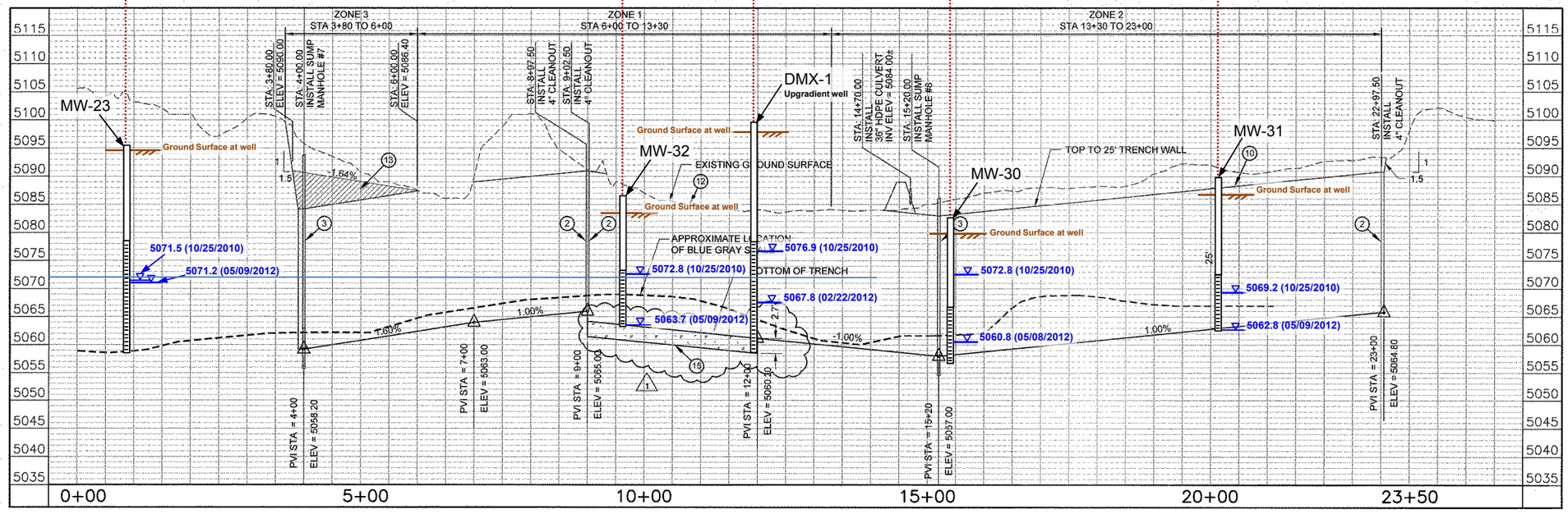



SEEPAGE TRENCH
PROFILE

HORIZONTAL 0 100 200 SCALE IN FEET

VERTICAL 0 10 20 SCALE IN FEET

URS
7720 N. 16th Street Suite 100
Phoenix, Arizona 85020
(602) 371-1100

KEY NOTES:

1. TO DEFLECT SURFACE STORMWATER FLOW, CONSTRUCT BERM TO ELEVATION 5088.0 WITH 10' WIDE TOP AND 3:1 SIDE SLOPES. SEE SECTION D, SHEET 4.
2. INSTALL CLEANOUT SEE DETAIL 6, SHEET 4.
3. INSTALL SUMP MANHOLE SEE DETAIL 1, SHEET 4.
4. CONTRACTOR TO PLACE SPOIL MATERIAL INTO AREA SHOWN TO ELEVATION 5088.0.
5. INSTALL 36" HDPE CULVERT WITH FLARED END SECTION, 170 LF AT 1% SLOPE. MATCH EXISTING GRADE AT INLET, OUTLET ELEVATION SET BY 1% SLOPE. WHERE TOP OF PIPEI S EXPOSED ADD 1 FOOT MINIMUM COVER WITH 3:1 SIDE SLOPES.
   ⚠1
6. CULVERT ENTRANCE COVERED WITH STRUCTURAL FILL PENDING STORMWATER ANALYSIS ACCEPTANCE, SEE DETAILS 8, SHEET 4.
7. CONSTRUCT A 10' DIA FLAT AREA AROUND 4" CLEANOUT, AND 48" DIA SUMP MANHOLE
8. NOT USED
9. 2" DISCHARGE PIPING TIE-IN AT EXISTING FLOW MEASUREMENT MANHOLE. UPSTREAM INSIDE EXISTING MANHOLE. INSTALL NEW FLOW METER UPSTREAM OF TIE-IN, IN NEW DISCHARGE PIPING.
10. RESTORE APPROXIMATE ORIGINAL CONTOUR OF MASS EXCAVATION FOR TRENCH ACCESS WITH 3 FT MINUMUM STRUCTURAL FILL. SEE SECTION C, SHEET 4 (ZONE 2).
11. INSTALL 6' HIGH CHAIN LINK FENCE AND GATES; SEE DETAIL 7, SHEET 4.
12. RESTORE APPROXIMATE ORIGINAL CONTOUR OF MASS EXCAVATION FOR TRENCH ACCESS WITH 3 FT MINUMUM STRUCTURAL FILL. SEE SECTION A, SHEET 4 (ZONE 1).
13. RESTORE FILL TO PROVIDE POSITIVE DRAINAGE, SEE PROFILE FOR ELEVATIONS AND SLOPE.
14. NEW 2" DISCHARGE PIPE TIE-IN.
15. WEATHERED ZONE REPLACED WITH 120 CY OF CLSM.

⚠1

# Figure 13
## Oct. 2010 vs. May 2012 Water Levels North Intercept Trench

| NO. | DATE | REVISION | DWN | CHD | EXD | RVWD | APVD | W.A. |
|---|---|---|---|---|---|---|---|---|
| 1 | 01/13/12 | AS-BUILTS | KLP | AKR | JDM | CDW | | FAC90371 |
| 0 | 10-29-10 | CONSTRUCTABILITY REVIEW | KLP | AKR | JDM | CDW | | FAC90371 |

FOUR CORNERS POWER PLANT
SEEPAGE TRENCH
PLAN AND PROFILE

APS

SCALE AS NOTED DATE 10-29-10

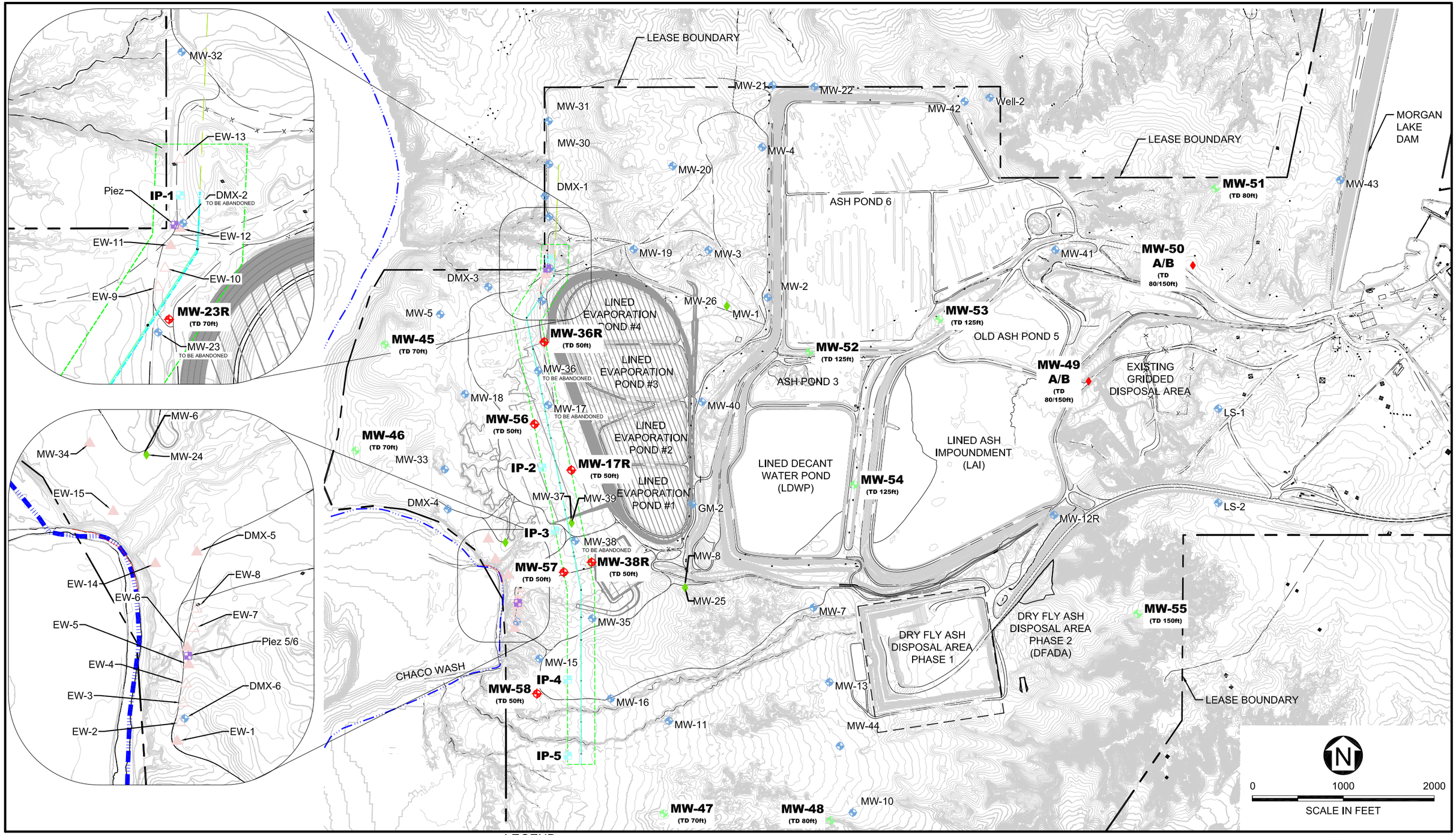
| DWN | APPROVED | W.A |
|---|---|---|
| KLP | DENNIS DEL GROSSO ENGINEERING SUPERVISOR | FAC90371 |
| CHD AKR | | |
| EXD JDM | | |
| RVWD CDW | | |

| UNIT | DISC | TYPE | SYS | NUMBER | SHEET |
|---|---|---|---|---|---|
| F123 | C | 47 | AWS | 161704 | 3 |

Two working days before you dig, CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT



DRAWING: P:\WRES\Arizona_Public_Service\23445947_APS_FCPP_Seepage_II\5.0_Technical\5.6_CADD\APS_EDCS_Drawings\2_DRAWING_REVISIONS\F123-C-47-AWS-161704-3.dwg




REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

LEGEND

- Monitor Well
- Piezometer
- Paired Monitor Wells
- Chaco Wash
- Extraction Well
- Offline Extraction Well
- Proposed SIT Piezometer
- Proposed Paired Monitor Wells
- Proposed Monitor Well
- SIT Replacement Monitor Well
- Limits of SIT Construction
- SIT Alignment

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

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# Proposed Monitor Well Locations

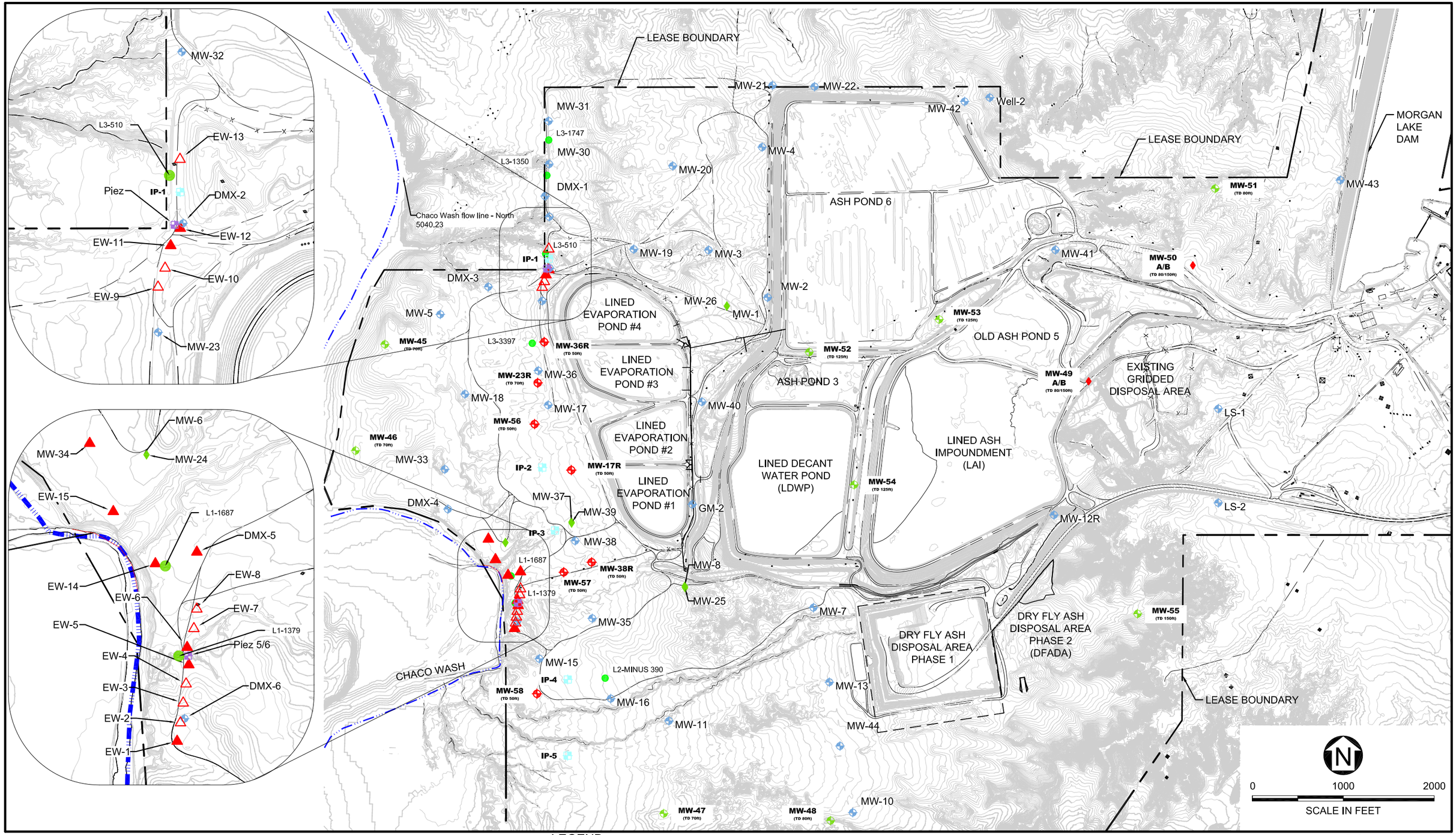
Arizona Public Service

Four Corners Power Plant

Figure 14

**Four Corners Power Plant**
Geohydrology Data Submittal
February 13, 2013

# Exhibit 1
Geologic Logs




REFERENCE: AERIAL: PROVIDED BY APS (AERIAL MAPPING COMPANY) FLIGHT DATE MAY 7TH, 2010, DATUM: NEW MEXICO STATE PLANE, TRANSVERSE MERCATOR-WEST ZONE, US SURVEY FOOT, N.A.D. 1983, N.A.V.D. 88. TOPOGRAPHY: FLOWN BY "AERO-GRAPHICS, INC." ON NOVEMBER 22, 2006, 40 WEST OAKLAND AVENUE, SALT LAKE CITY, UTAH 84115, DATUM: NEW MEXICO STATE PLANE, NAD27/NGVD29, WEST ZONE, US SURVEY FOOT USGS TOPOGRAPHIC QUAD: FRUITLAND, THE HOGBACK NORTH, NM, 1979. WELL AND CHACO WASH SURVEY, N.A.D.1983, N.A.V.D. 88 BY SOUDER MILLER JULY 2012

| DATUM: | CONTROL POINT | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| | EMMA | N2,066,529.495 | E2,528,708.477 | 5382.251' |
| | HV53 | N2,070,581.505 | E2,529,275.542 | 5331.214' |
| | HV61 | N2,070,581.682 | E2,520,166.590 | 5085.898' |

LEGEND

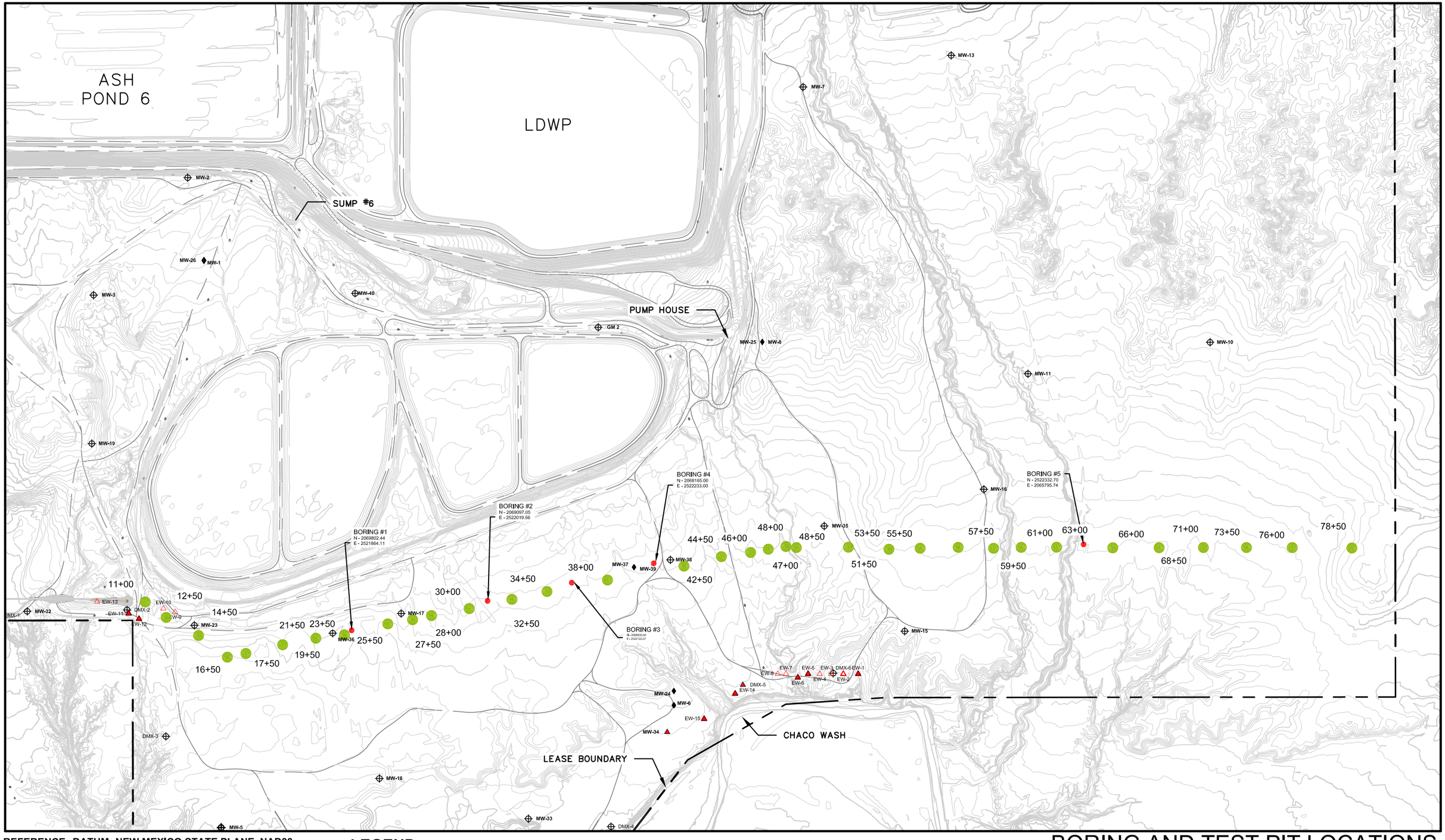
- Monitoring Well
- Piezometer
- Chaco Wash
- SOIL BORING
- Paired Monitoring Wells
- Extraction Well
- Offline Extraction Well
- Proposed Monitoring Wells
- Proposed Piezometer
- Proposed Paired Monitoring Wells

# SITE MAP

## Arizona Public Service
## Four Corners Power Plant

Figure 1

P:\WRES\Arizona_Public_Service\23446329_APS_FCPP_Wells_&_Geology\5_0_Technical\5_6_CADD\Figures\ A20167.dwg




REFERENCE: DATUM: NEW MEXICO STATE PLANE, NAD83, WEST ZONE, US SURVEY FOOT.

0 500 1000 1500

SCALE IN FEET
1"=400'

URS

## LEGEND:

- MW-16 **Monitoring Well**
- MW-25 **Monitoring Well**
- **Boring - October 2012**
- EW-15 **Extraction Well**
- EW-8 **Extraction Well**

**NOT FOR CONSTRUCTION**
**DRAFT 1-31-13**

# BORING AND TEST PIT LOCATIONS

South Intercept Trench
Four Corners Power Plant

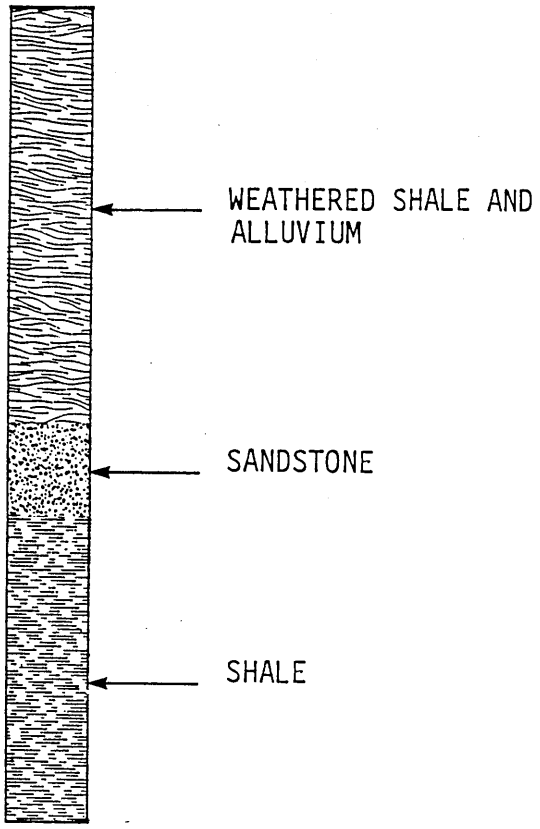
Figure 2

P:\WRES\Arizona_Public_Service\23446329_APS_FCPP_Wells_&_Geology\5_0_Technical\5_6_CADD\Figures\ A20178.dwg

# APPENDIX A

# MONITOR WELL LITHOLOGIC LOGS

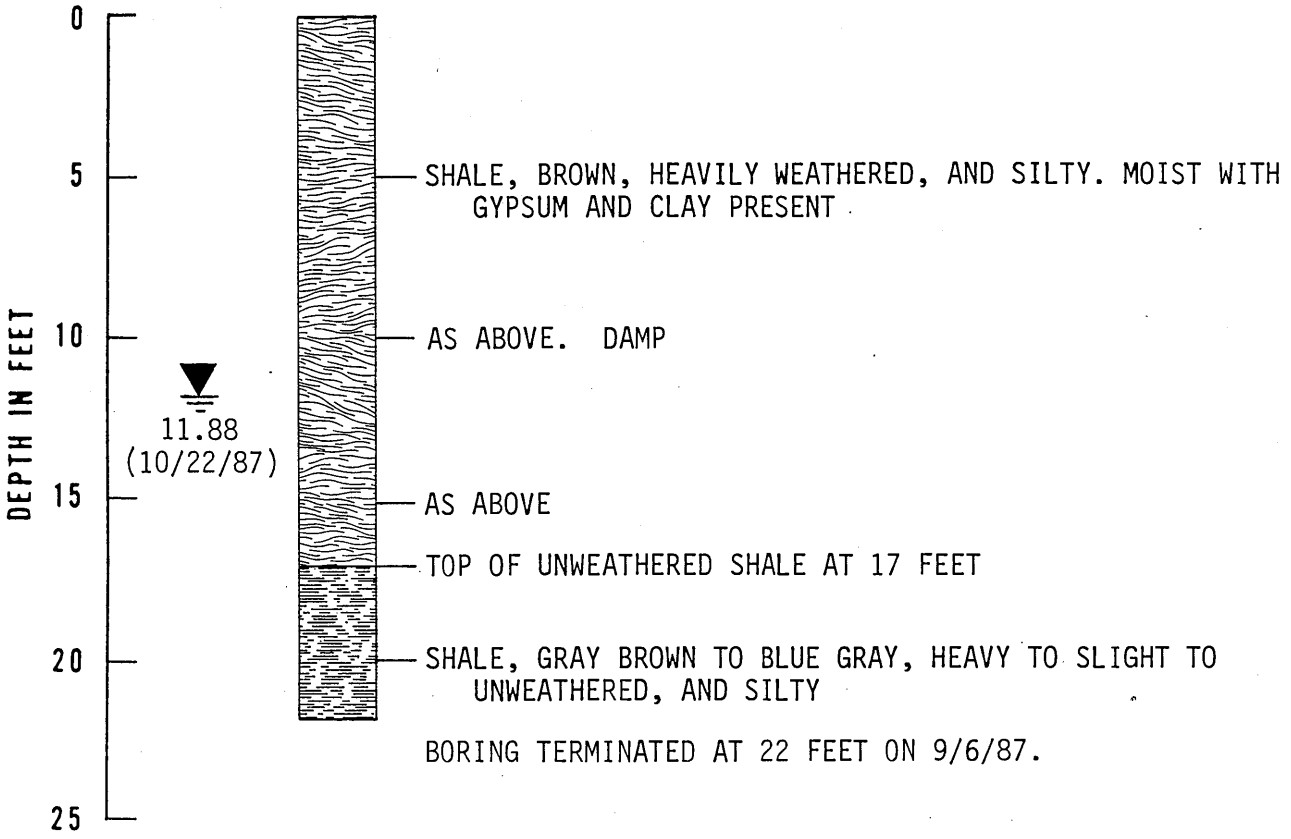
# LITHOLOGIC LOG




# KEY TO BORINGS

# LITHOLOGIC LOG

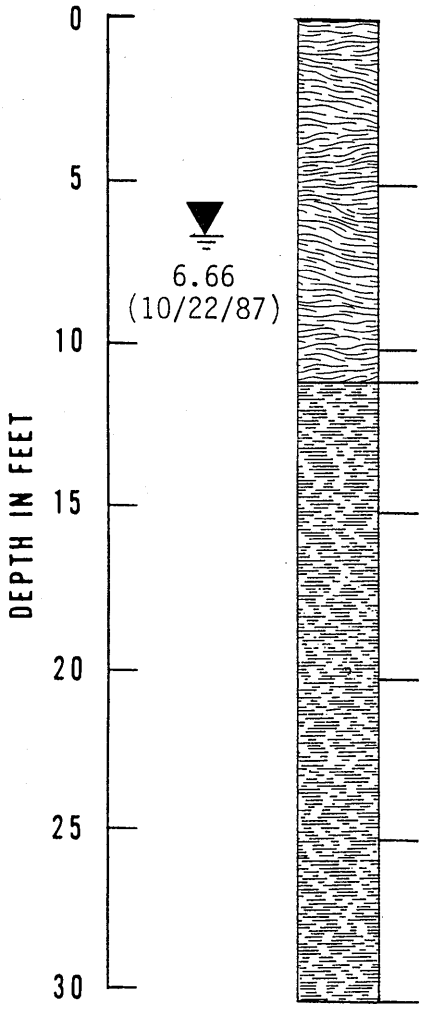
**SURFACE ELEVATION** 5137.05(e) FT.
**MEASURING POINT** 5139.10(e) FT.




## BORING MW-1

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5147.93 FT.**
**MEASURING POINT** **5149.43 FT.**




SILTY CLAY, BROWN, HEAVILY WEATHERED

AS ABOVE
TOP OF UNWEATHERED BEDROCK AT 11 FEET

SILTY CLAY TO SHALE, BROWN TO GRAY, MODERATELY WEATHERED. MOISTURE PRESENT IN CUTTINGS MATRIX

SHALE, GRAY, SILTY, SLIGHTLY WEATHERED. MOISTURE PRESENT IN CUTTINGS

SHALE, GRAY, UNWEATHERED. SOME MOISTURE IN CUTTINGS

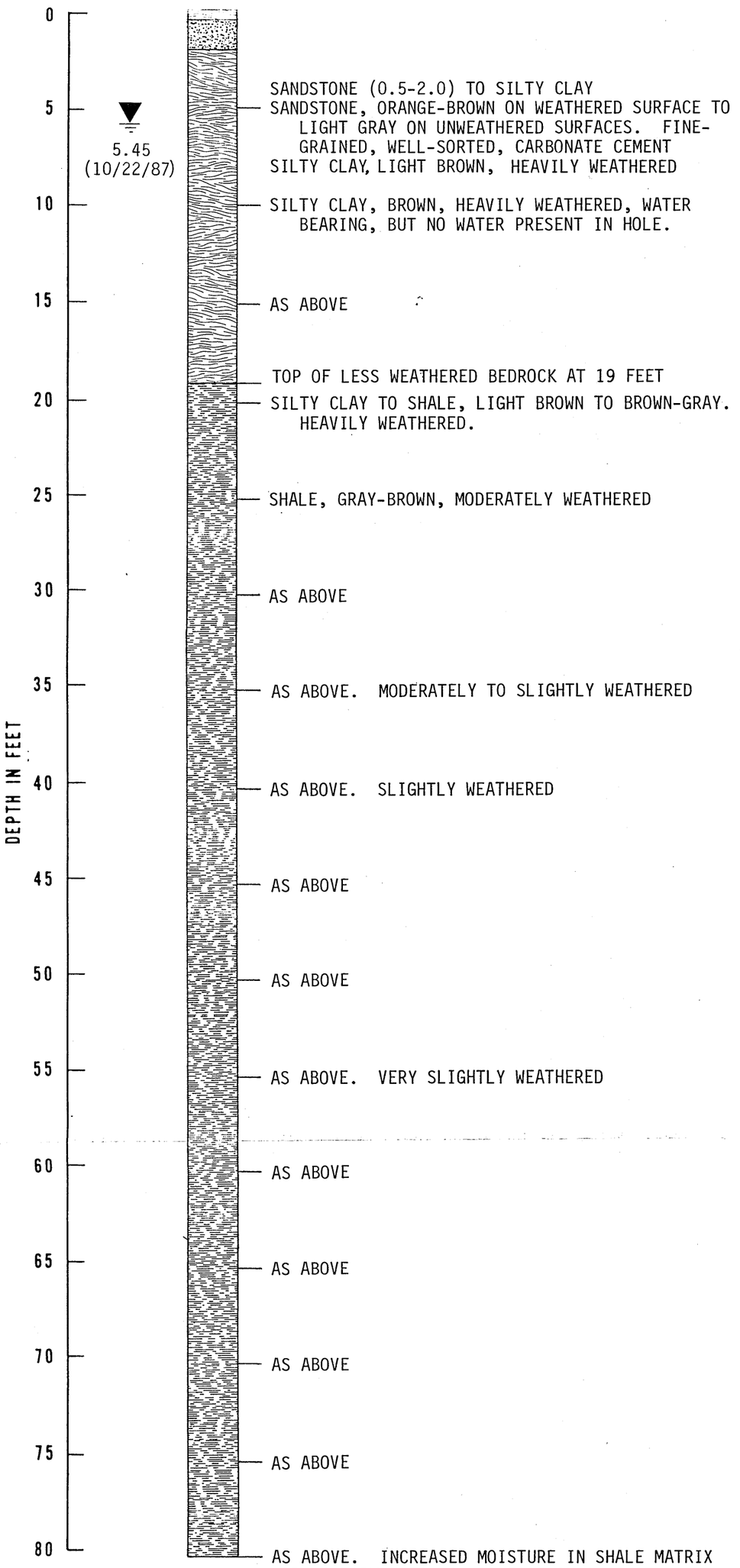
AS ABOVE

BORING TERMINATED AT 30 FEET ON 3/13/87.

## BORING MW-2

# LITHOLOGIC LOG

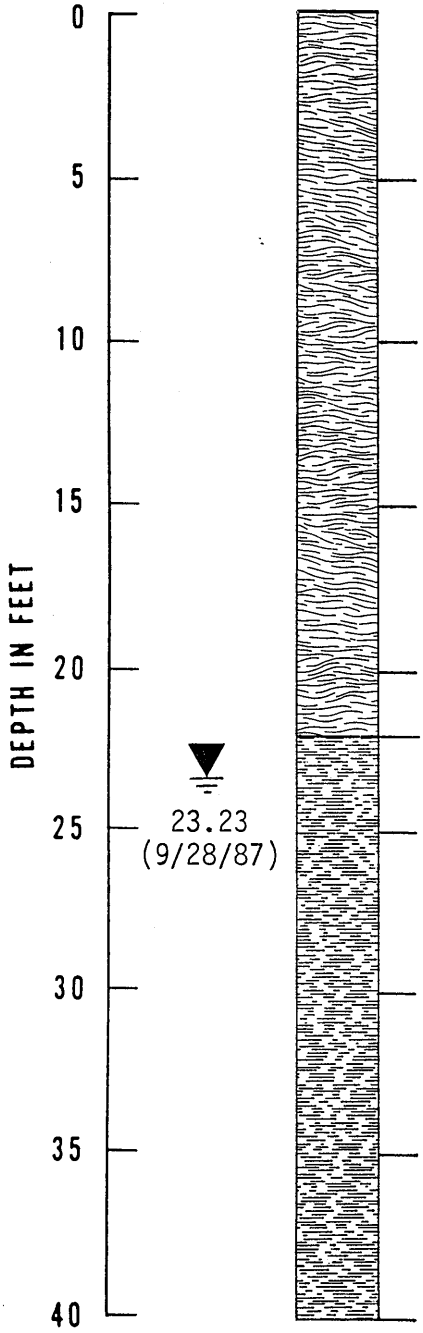
**SURFACE ELEVATION** **5124.06 FT.**
**MEASURING POINT** **5125.81 FT.**




BORING MW-3

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5146.38 FT.**
**MEASURING POINT** **5147.88 FT.**




SILTY CLAY TO SHALE, LIGHT BROWN TO GRAY, WEATHERED

SILTY SHALE, GRAY-BROWN, HEAVILY WEATHERED

AS ABOVE. GRAY

AS ABOVE. MODERATELY WEATHERED

TOP OF UNWEATHERED BEDROCK AT 22 FEET

AS ABOVE. SLIGHTLY WEATHERED

AS ABOVE

AS ABOVE. GRAY, UNWEATHERED

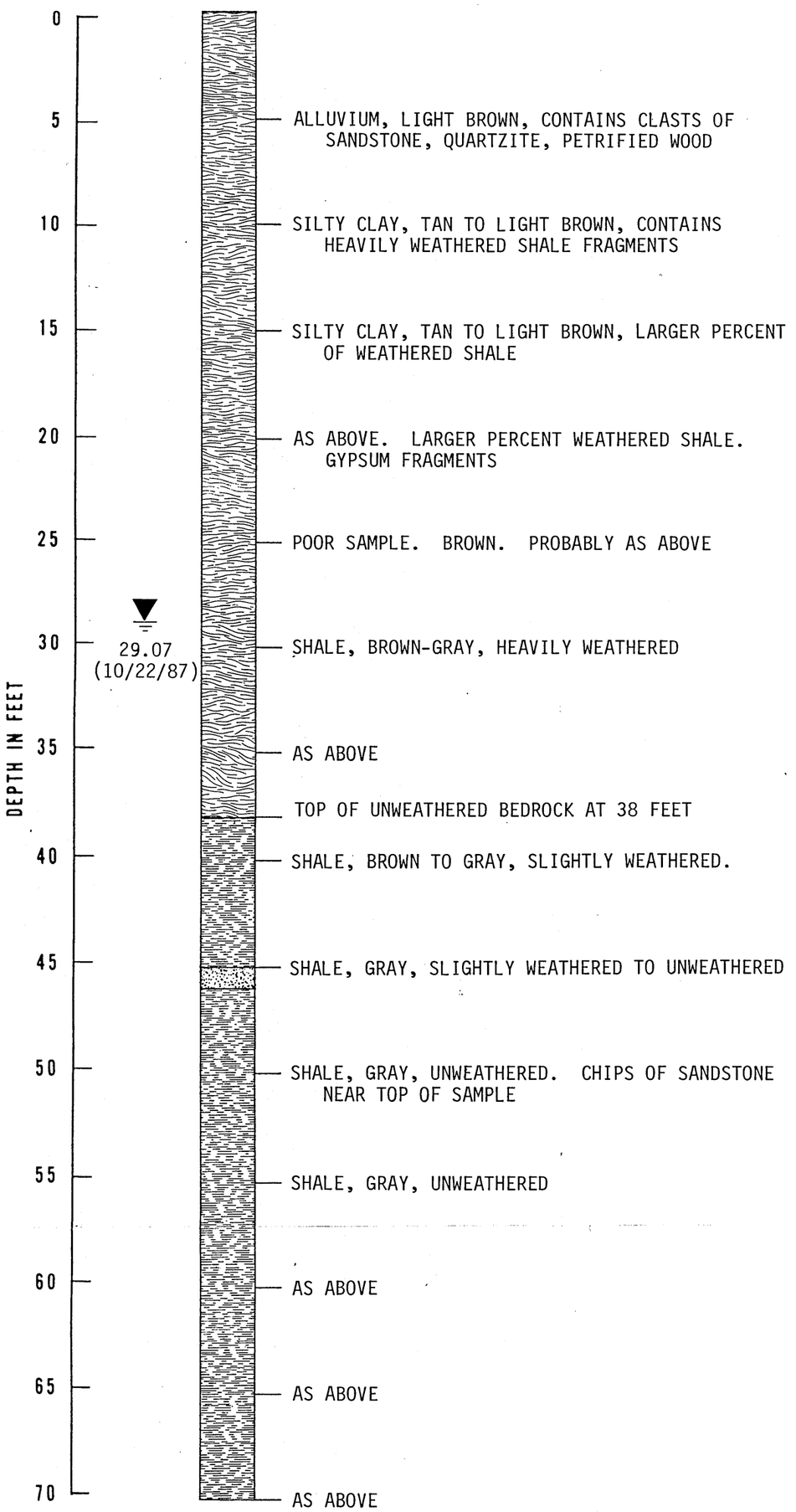
AS ABOVE. NO WATER

BORING TERMINATED AT 40 FEET ON 3/12/87.

## BORING MW-4

# LITHOLOGIC LOG

**SURFACE ELEVATION** 5084.45 FT.
**MEASURING POINT** 5086.45 FT.

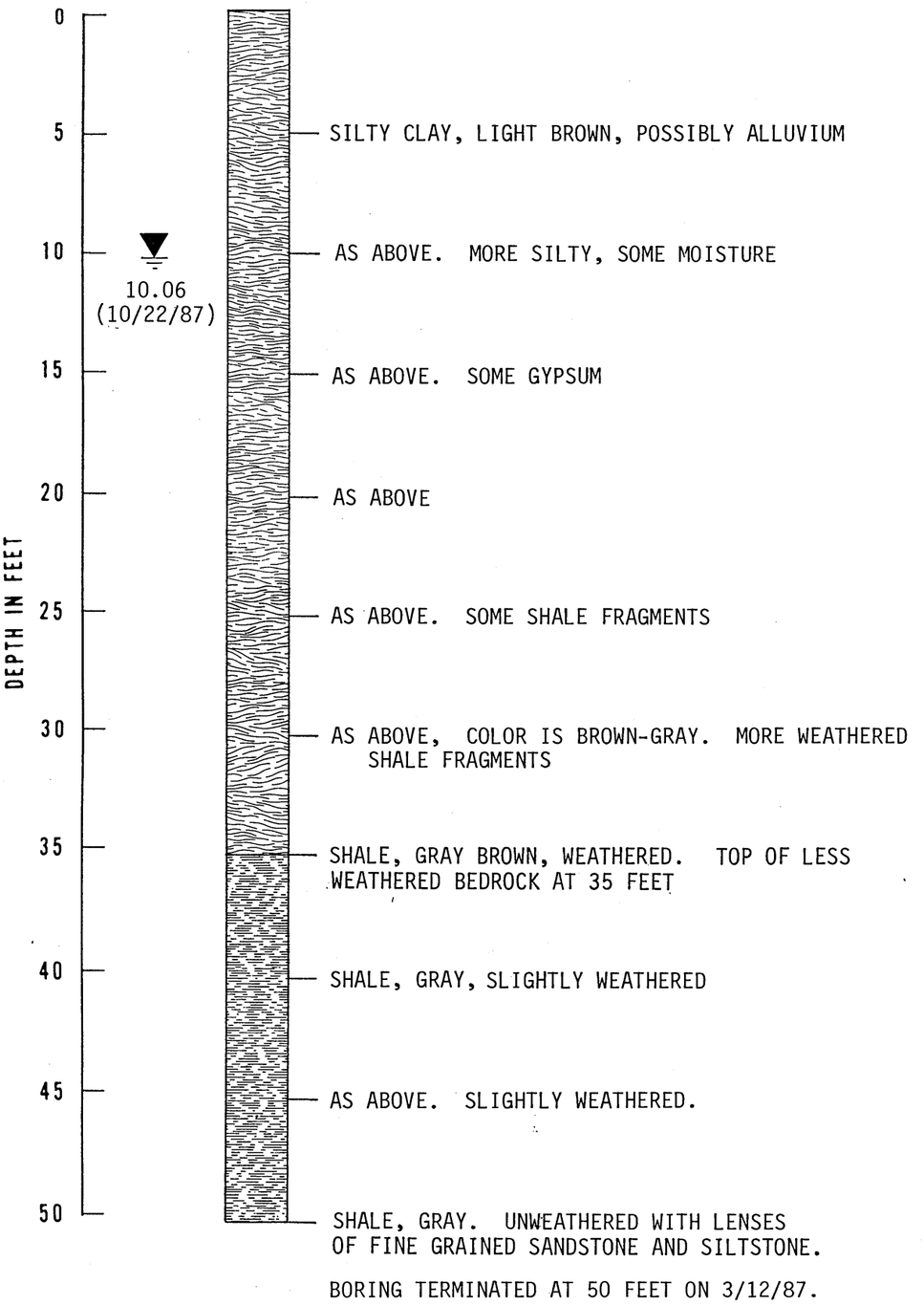



BORING TERMINATED AT 70 FEET ON 3/12/87.
NOTE: LITHOLOGIC LOG IS BASED ON RESULTS FROM THE 1st HOLE THAT WAS DRILLED. A 2nd HOLE, OFFSET 25 FEET, WAS DRILLED FOR CONSTRUCTING THE MONITOR WELL.

BORING MW-5

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5078.20 FT.**
**MEASURING POINT** **5079.70 FT.**

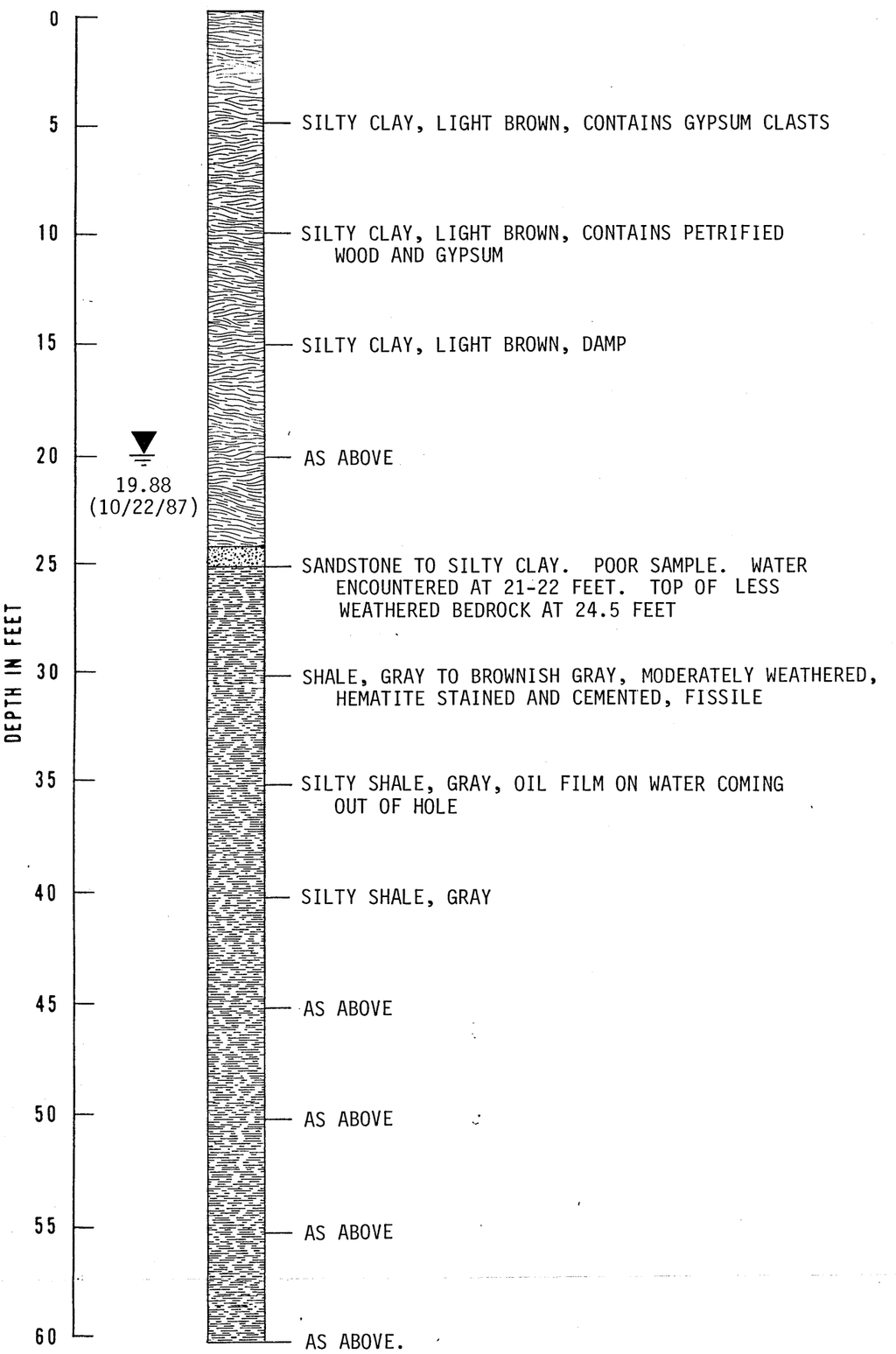



BORING TERMINATED AT 50 FEET ON 3/12/87.

BORING MW-6

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5146.62 FT.**
**MEASURING POINT** **5148.52 FT.**

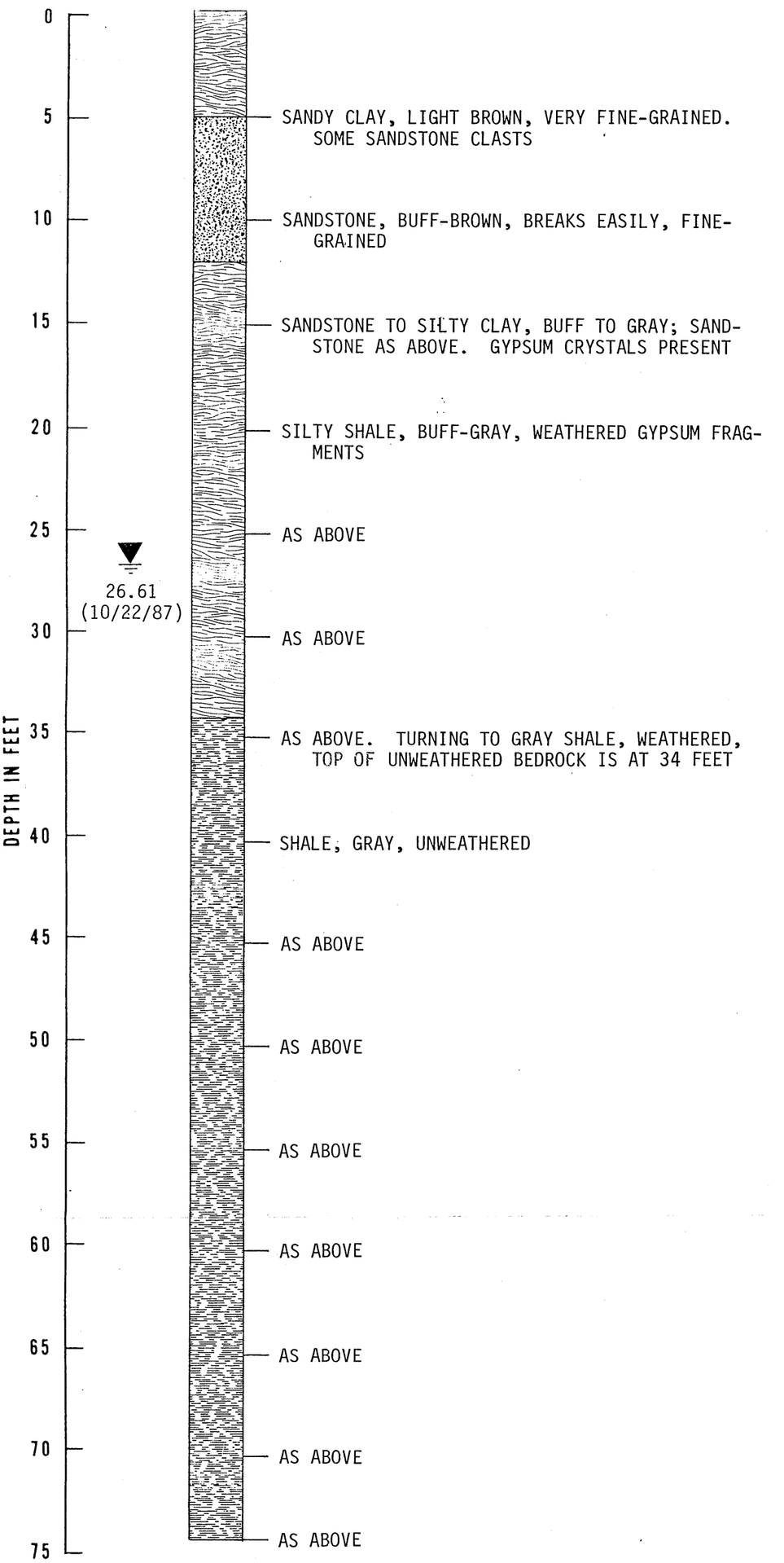



BORING TERMINATED AT 60 FEET ON 3/11/87.
NOTE: LITHOLOGIC LOG IS BASED ON RESULTS FROM THE 1st HOLE THAT WAS DRILLED. A 2nd HOLE, OFFSET BY 15 FEET, WAS DRILLED FOR CONSTRUCTING THE MONITOR WELL.

BORING MW-7

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5118.95 FT.**
**MEASURING POINT** **5120.95 FT.**

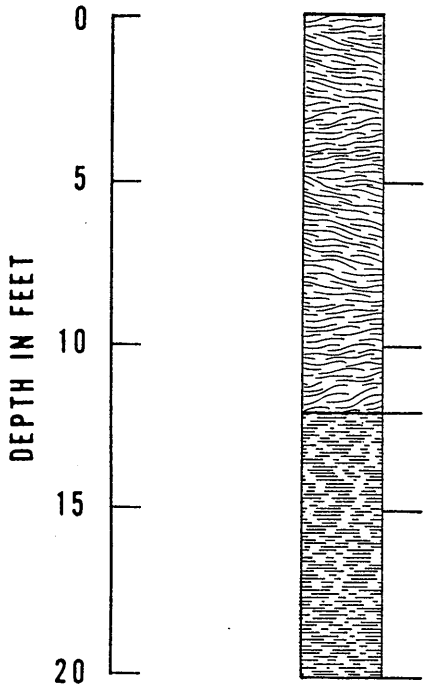



BORING TERMINATED AT 74 FEET ON 3/11/87.
NOTE: LITHOLOGIC LOG IS BASED ON RESULTS FROM THE 1st HOLE THAT WAS DRILLED. A 2nd HOLE, OFFSET BY 35 FEET, WAS DRILLED FOR CONSTRUCTING THE MONITOR WELL.

BORING MW-8

# LITHOLOGIC LOG

**SURFACE ELEVATION 5173 FT. (est.)**
**MEASURING POINT**




SILTY CLAY, LIGHT BROWN, DRY TO DAMP, GYPSUM FRAGMENTS

SILTY SHALE, GRAY, WEATHERED

TOP OF UNWEATHERED BEDROCK AT 12 FEET.

SILTY SHALE, GRAY, WEATHERED, GYPSUM FRAGMENTS (VEIN POSSIBLE).

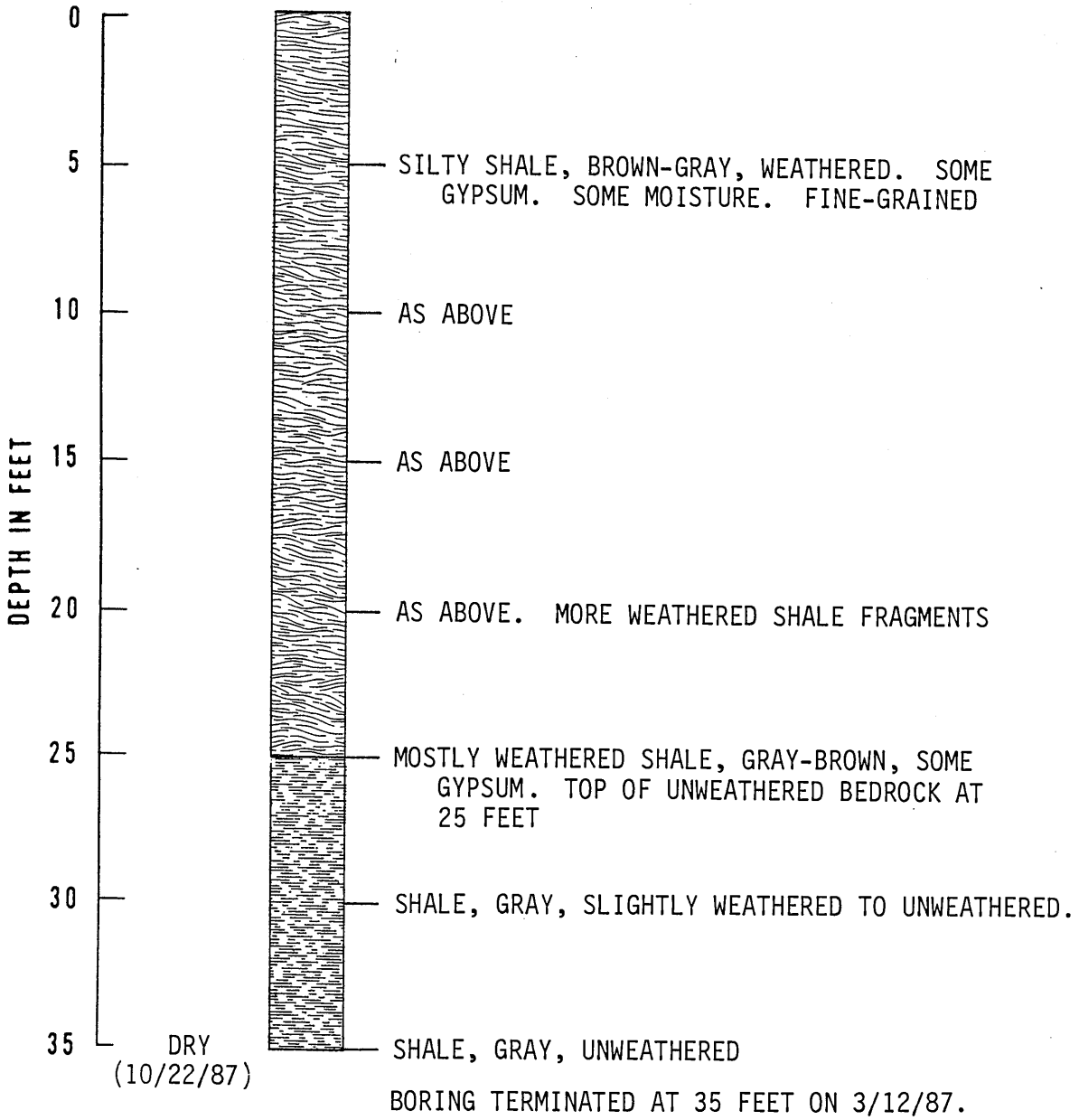
SHALE, GRAY, UNWEATHERED

BORING TERMINATED AT 20 FEET ON 3/11/87.
HOLE WAS BACKFILLED WITH CUTTINGS AND ABANDONED.

## BORING MW-9

# LITHOLOGIC LOG

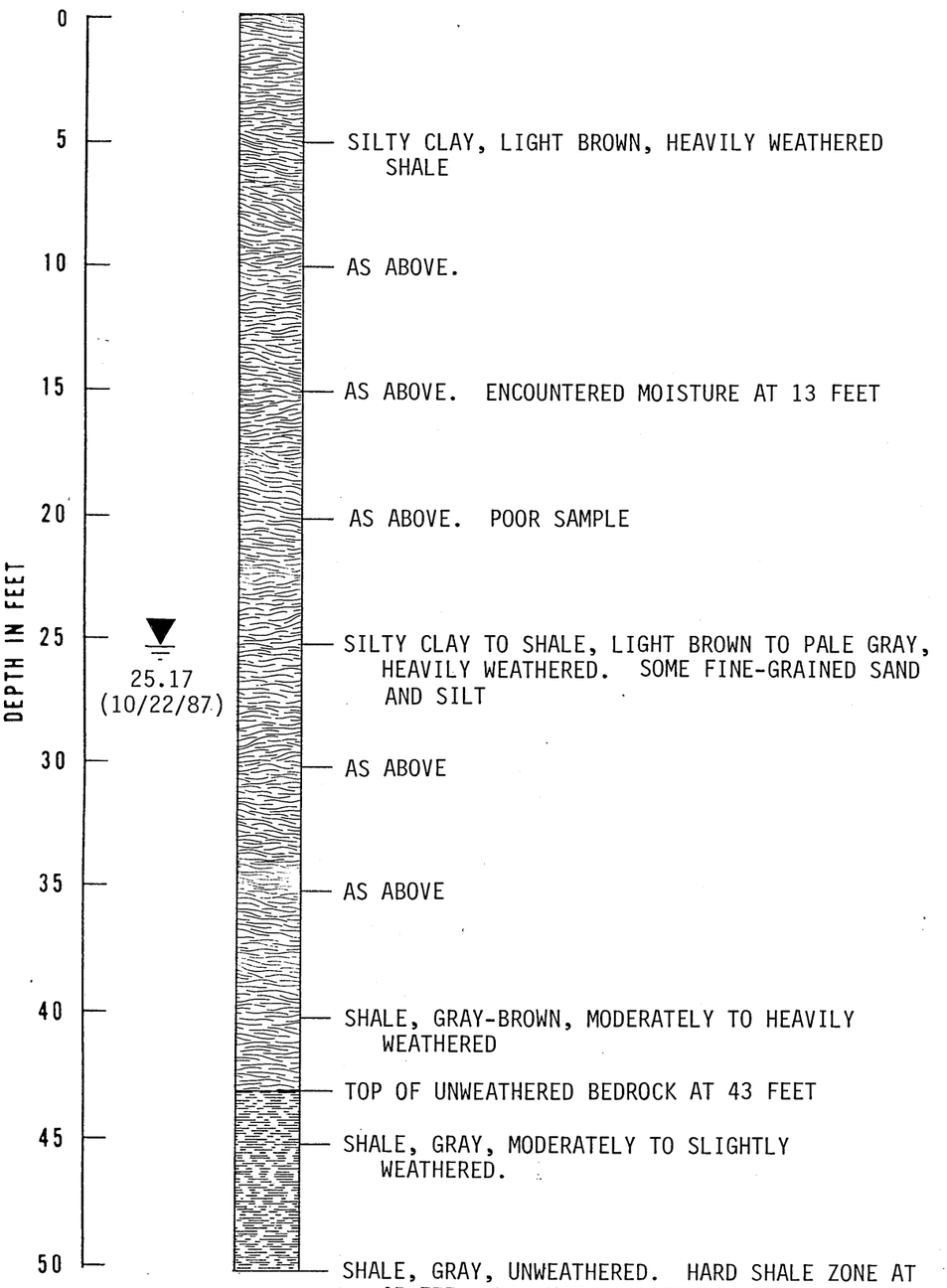
| | |
|---|---|
| **SURFACE ELEVATION** | **5147.38 FT.** |
| **MEASURING POINT** | **5148.88 FT.** |




## BORING MW-10

## LITHOLOGIC LOG

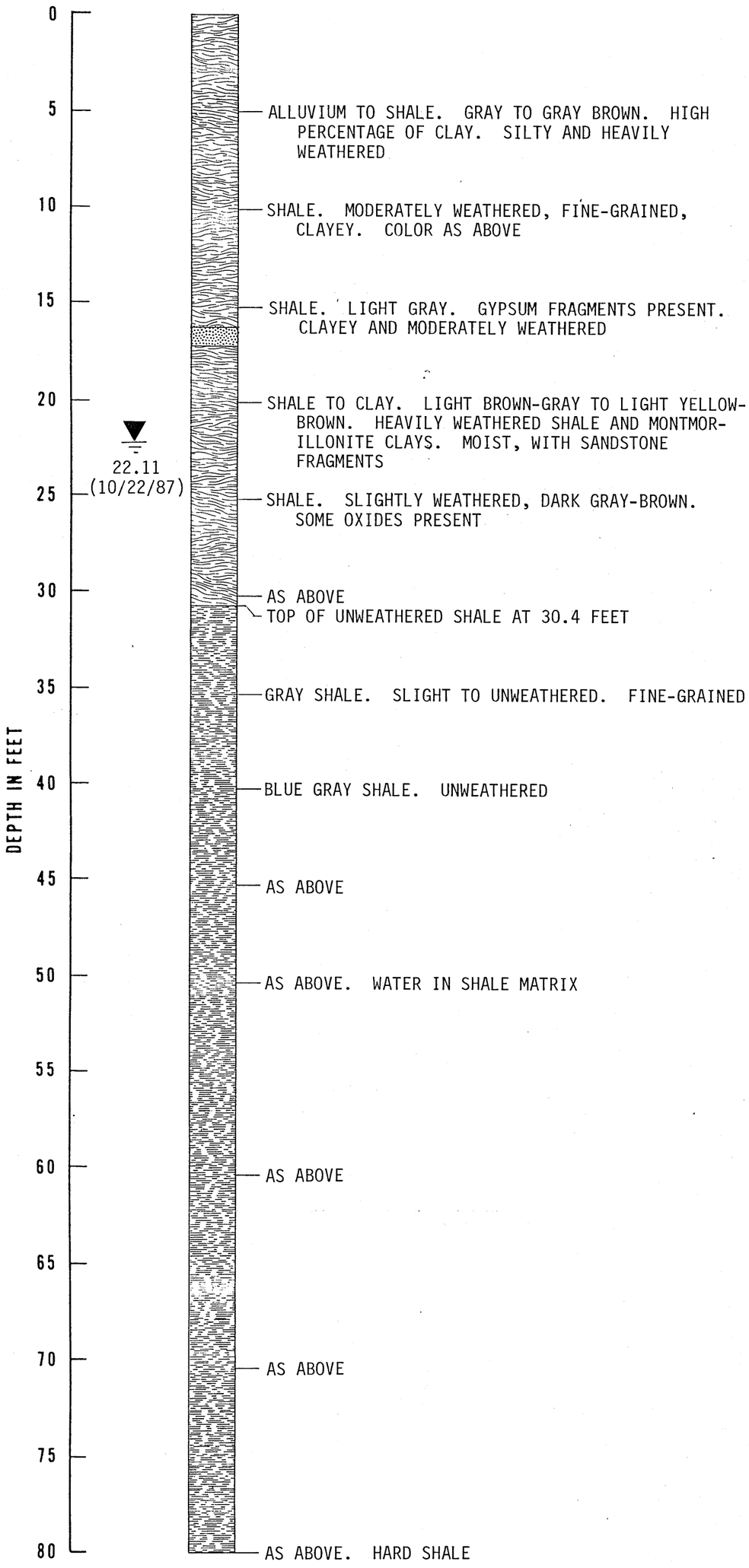
| | |
|---|---|
| **SURFACE ELEVATION** | **5109.01 FT.** |
| **MEASURING POINT** | **5111.31 FT.** |




BORING MW-11

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5196.63 FT.**
**MEASURING POINT** **5198.43 FT.**

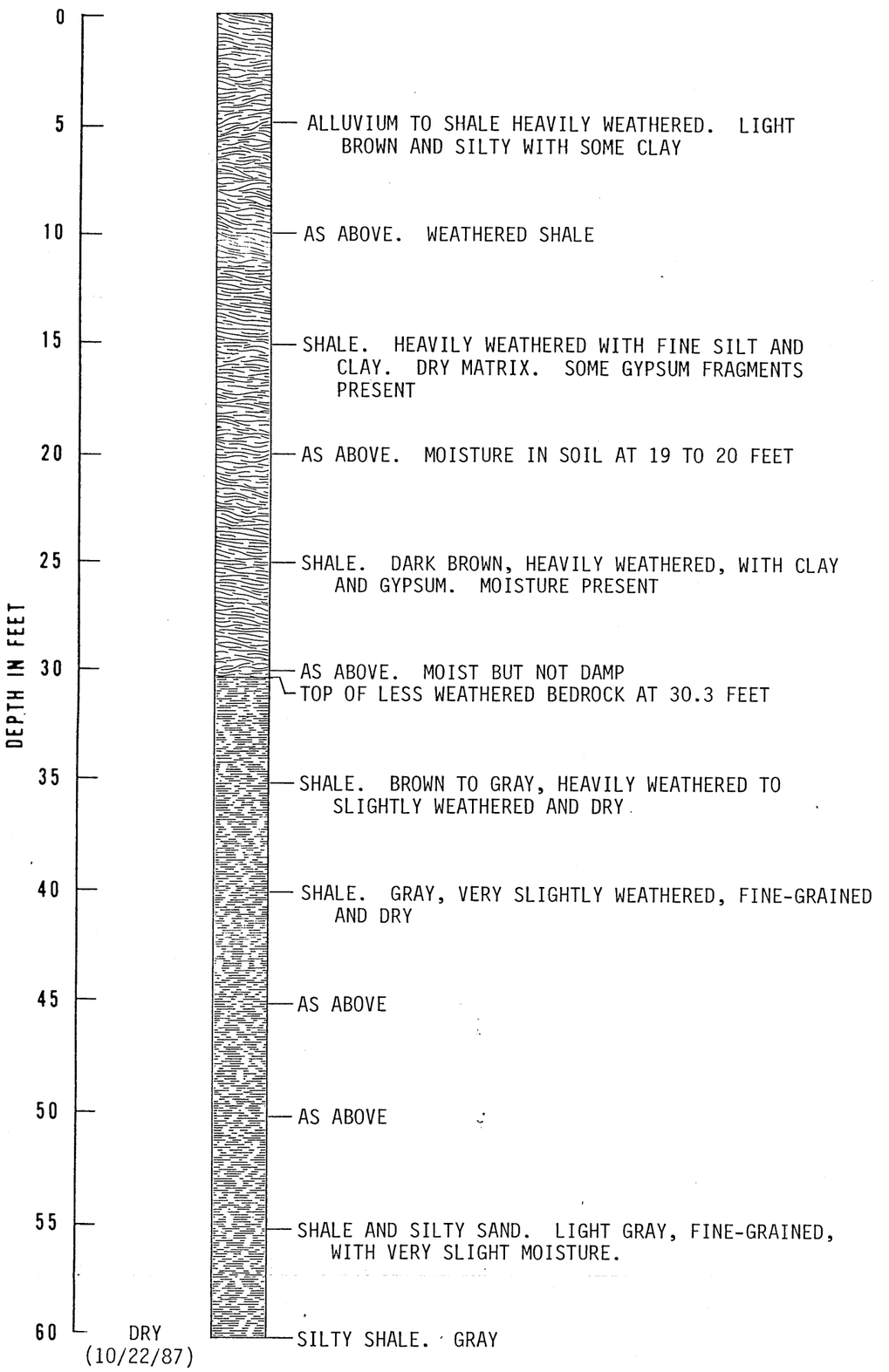



BORING TERMINATED AT 80 FEET ON 8/31/87.
NOTE: LITHOLOGIC LOG WAS BASED ON THE FIRST HOLE THAT WAS DRILLED. A 2nd HOLE, OFFSET 10 FEET, WAS DRILLED ON 9/1/87 FOR CONSTRUCTING THE MONITOR WELL.

BORING MW-12

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5147.39 FT.**
**MEASURING POINT** **5149.14 FT.**

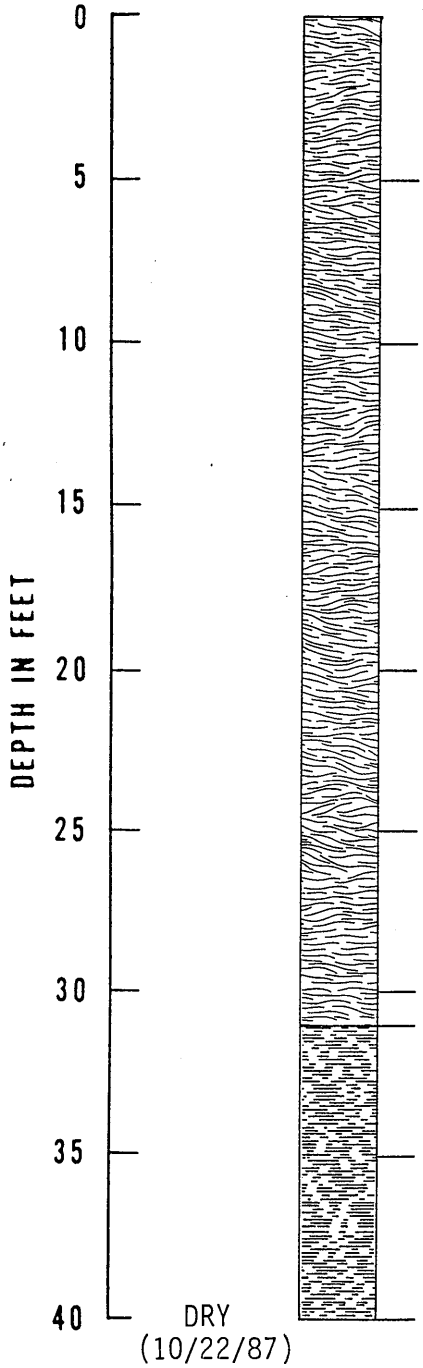



BORING TERMINATED AT 60 FEET ON 8/31/87.

BORING MW-13

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5177.28 FT.**
**MEASURING POINT** **5179.31 FT.**




ALLUVIUM TO SHALE. HEAVILY WEATHERED. BROWN TO LIGHT BROWN WITH SANDSTONE, SILTSTONE, SHALE AND GYPSUM FRAGMENTS

SHALE. HEAVILY WEATHERED, LIGHT BROWN TO LIGHT GRAY. MORE SILT AND SOME CLAY. SAME FRAGMENTS AS ABOVE

AS ABOVE. MORE GRAY IN COLOR

SHALE. HEAVILY WEATHERED, LIGHT BROWN/GRAY, WITH SILT AND SOME CLAY

AS ABOVE. MODERATELY WEATHERED WITH SOME MOISTURE IN THE SHALE

AS ABOVE.
TOP OF UNWEATHERED SHALE AT 31 FEET

SHALE. UNWEATHERED, GRAY, WITH MOISTURE PRESENT

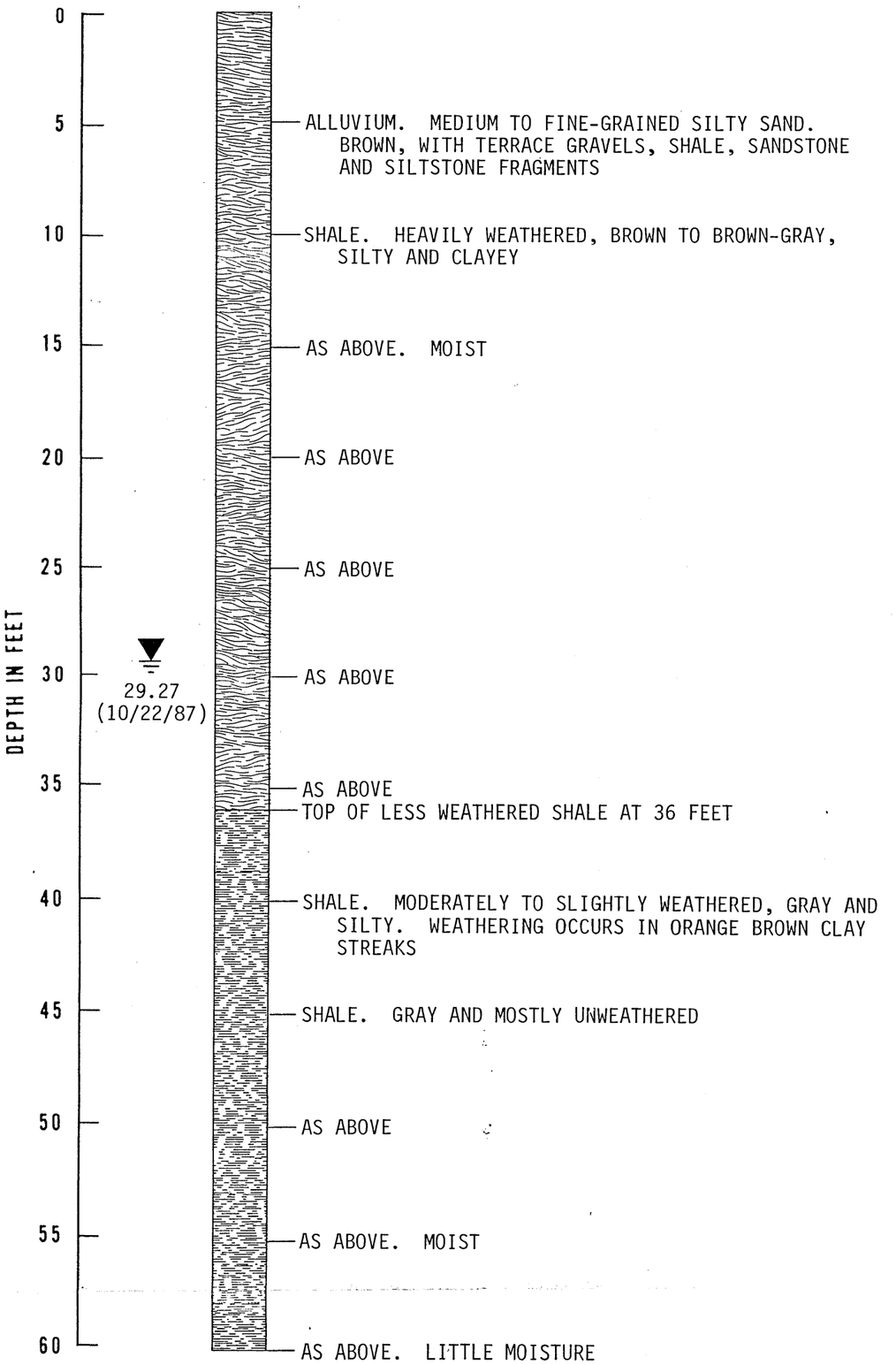
SHALE. GRAY, WITH MINOR SILTY SANDSTONE FRAGMENTS AND POWDER PRESENT. LITTLE MATRIX MOISTURE

BORING TERMINATED AT 40 FEET ON 8/31/87.

## BORING MW-14

## LITHOLOGIC LOG

**SURFACE ELEVATION** **5089.86 FT.**
**MEASURING POINT** **5091.46 FT.**

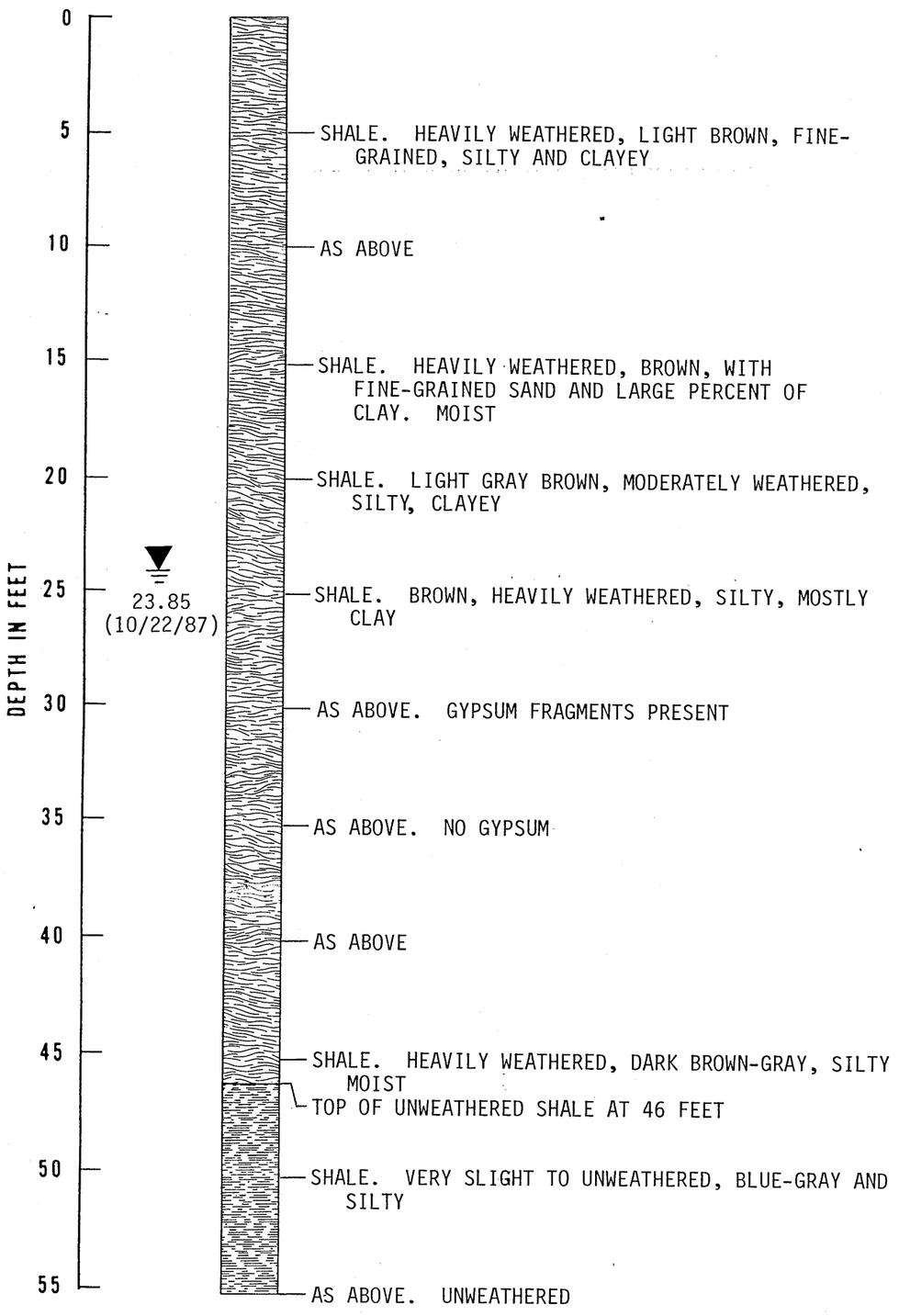



BORING TERMINATED AT 60 FEET ON 9/1/87.

BORING MW-15

## LITHOLOGIC LOG

**SURFACE ELEVATION** **5096.44 FT.**
**MEASURING POINT** **5099.94 FT.**

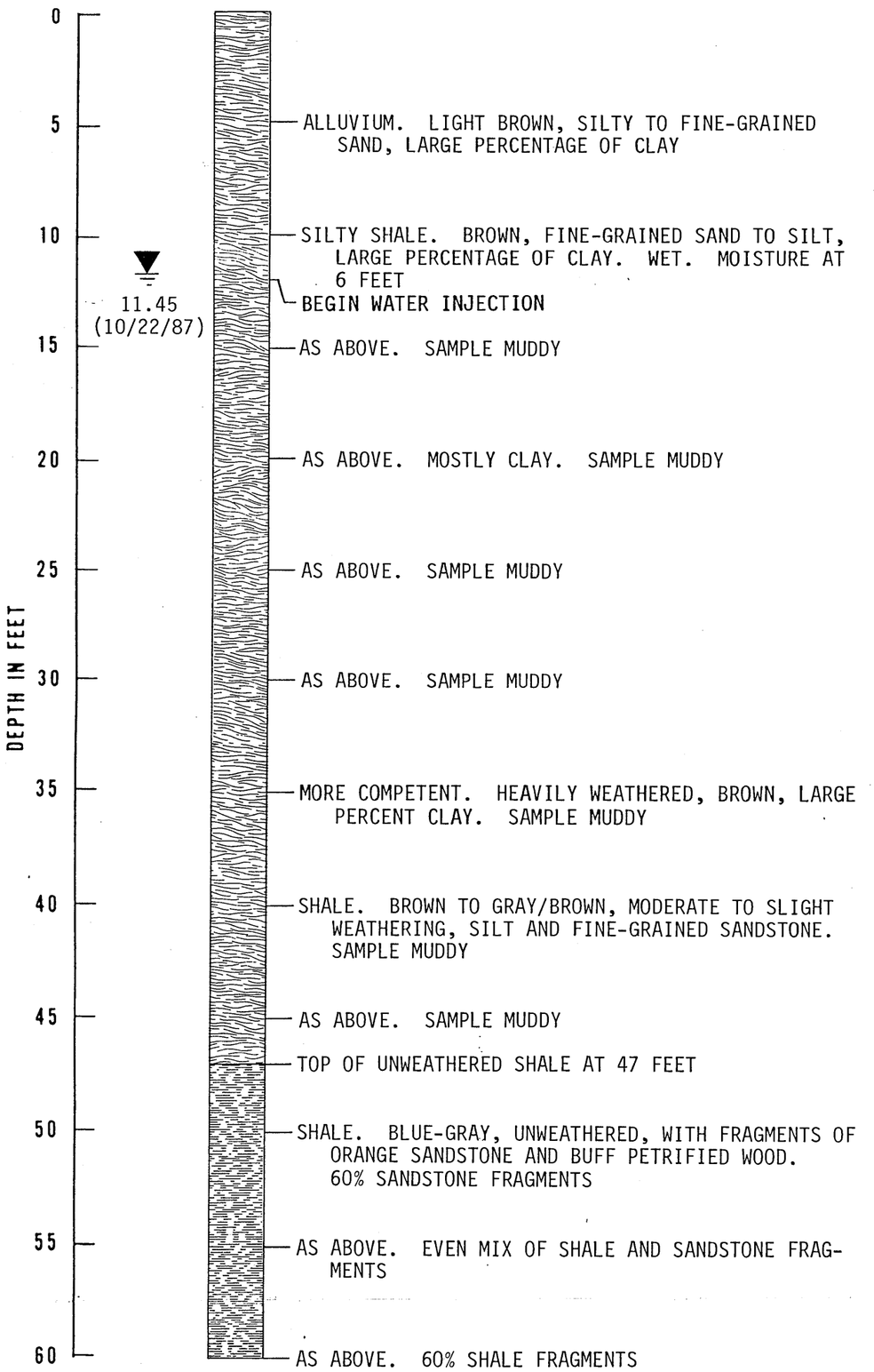



BORING TERMINATED AT 55 FEET ON 9/2/87.

BORING MW-16

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5092.03 FT.**
**MEASURING POINT** **5094.78 FT.**

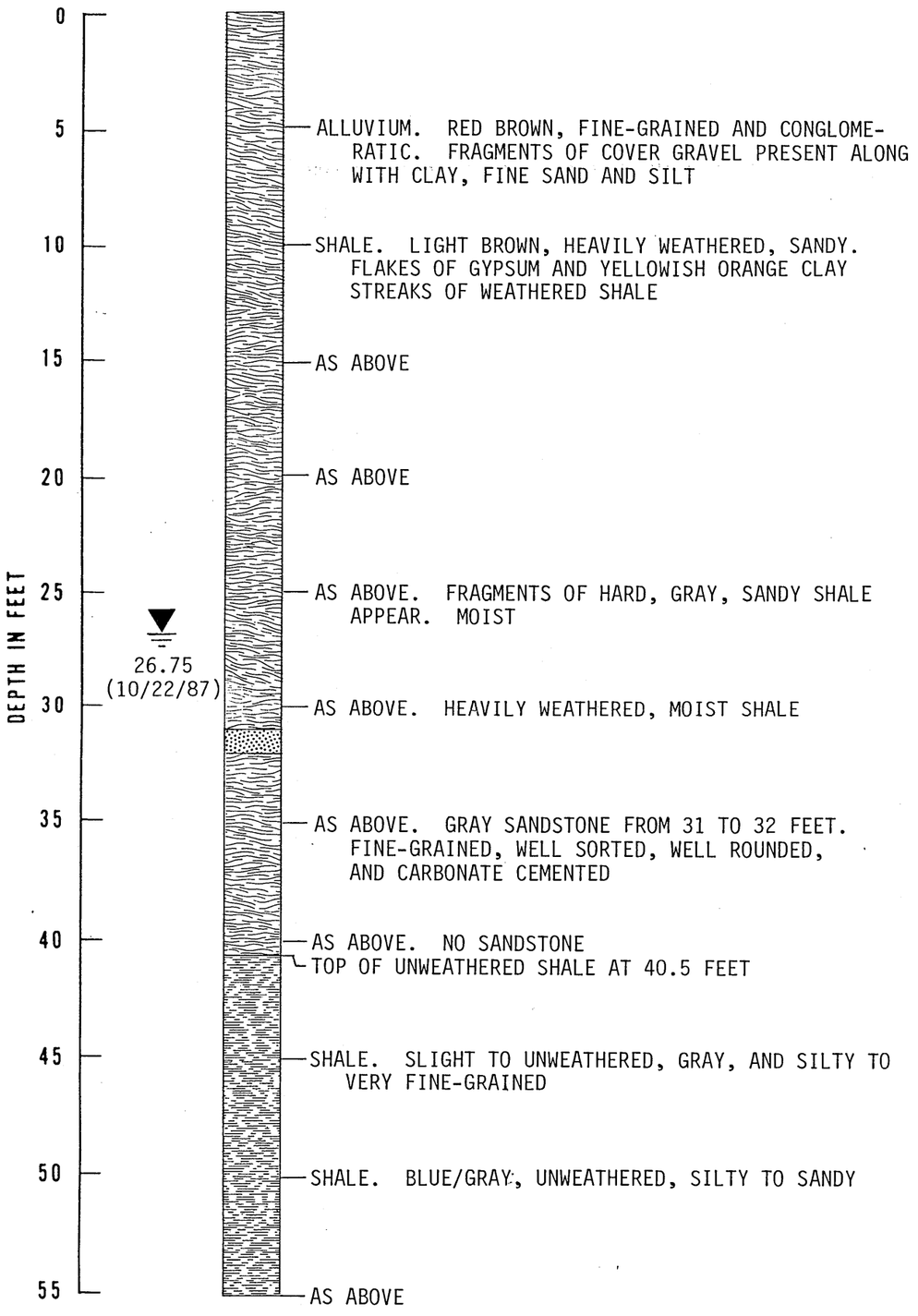



BORING TERMINATED AT 60 FEET ON 9/2/87.

BORING MW-17

# LITHOLOGIC LOG

**SURFACE ELEVATION** 5085.78 FT.
**MEASURING POINT** 5087.48 FT.

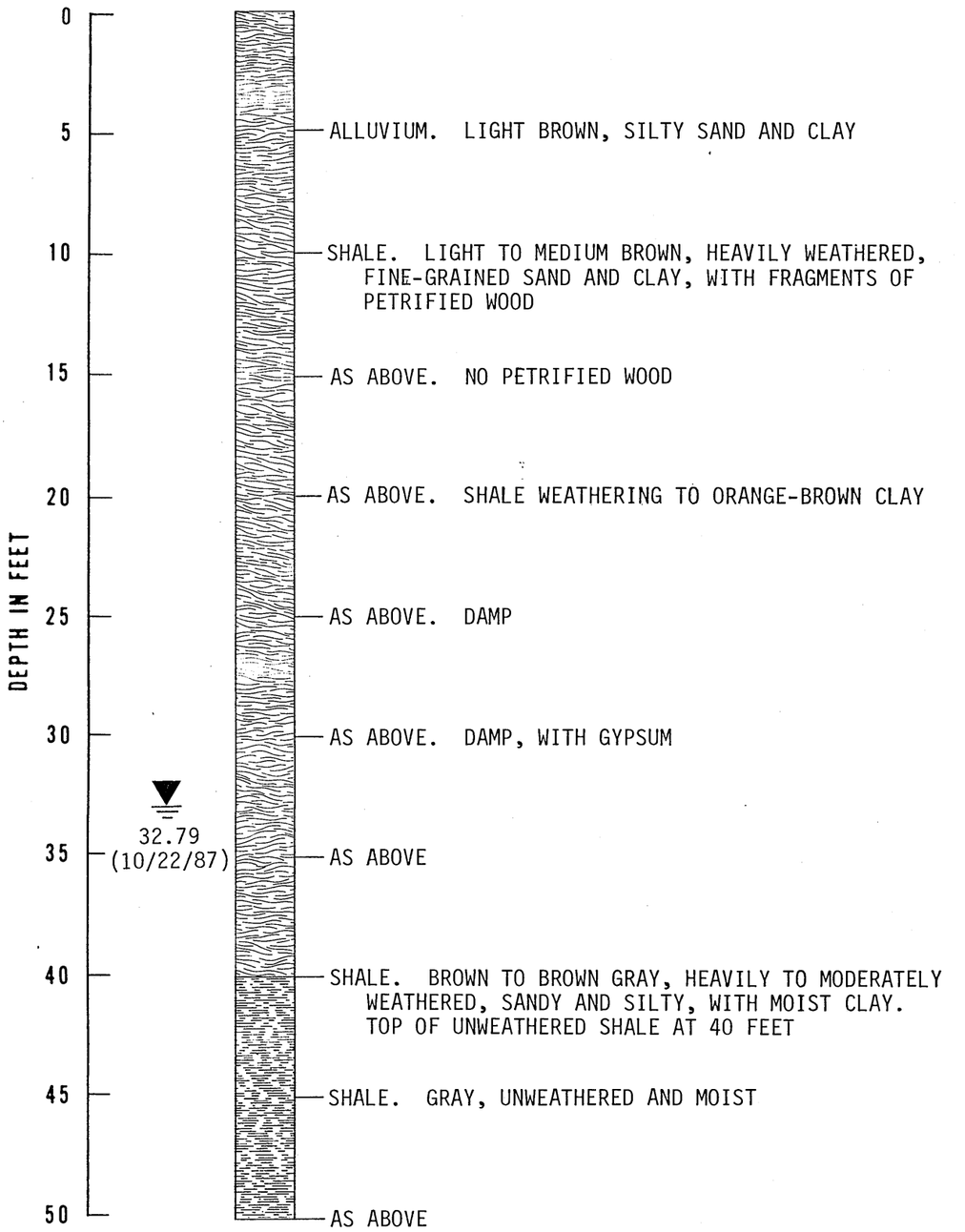



BORING TERMINATED AT 55 FEET ON 9/3/87.

BORING MW-18

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5123.73 FT.**
**MEASURING POINT** **5125.78 FT.**

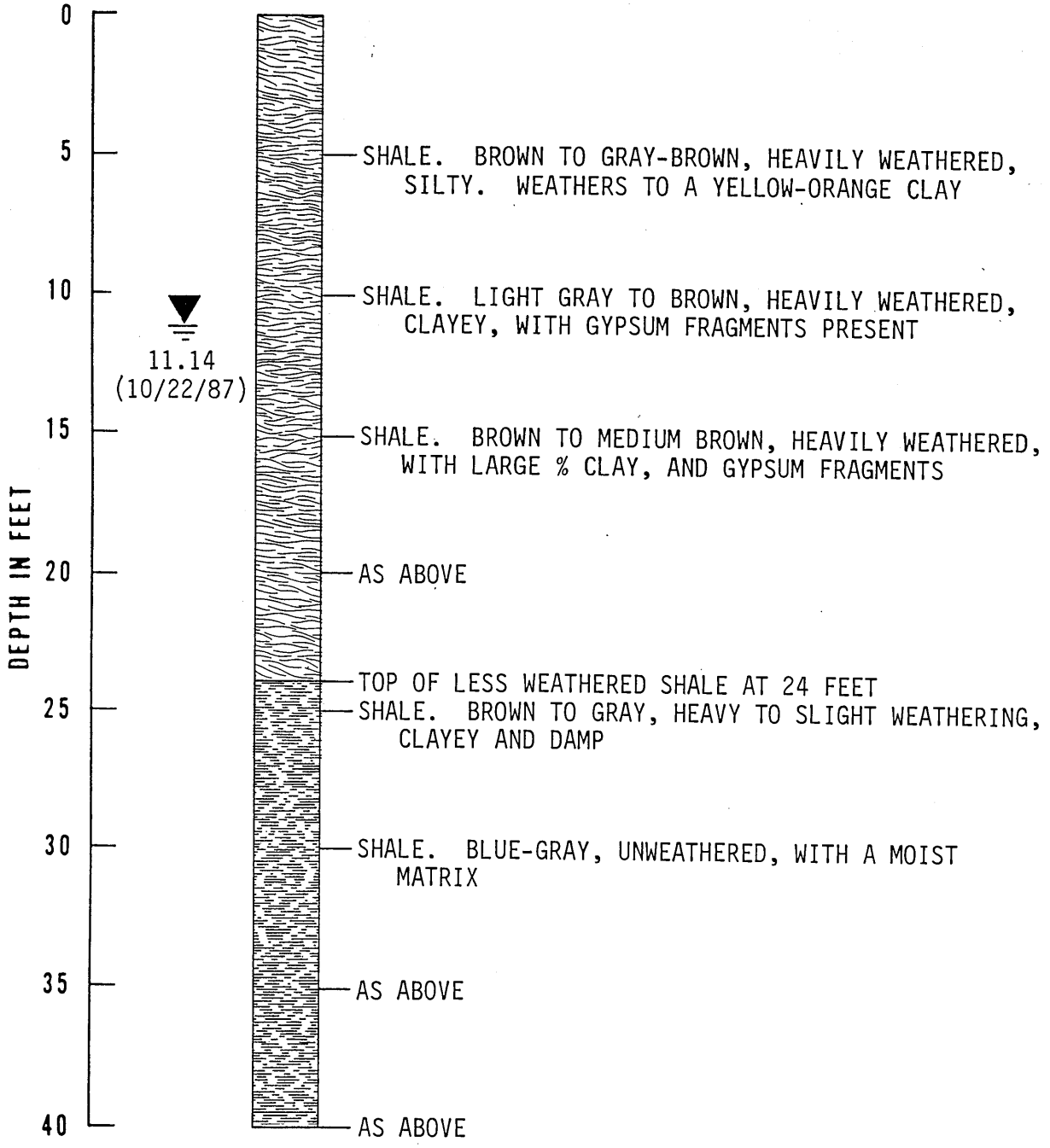



BORING TERMINATED AT 50 FEET ON 9/3/87.

BORING MW-19

# LITHOLOGIC LOG

| | |
|---|---|
| **SURFACE ELEVATION** | **5125.63 FT.** |
| **MEASURING POINT** | **5128.33 FT.** |

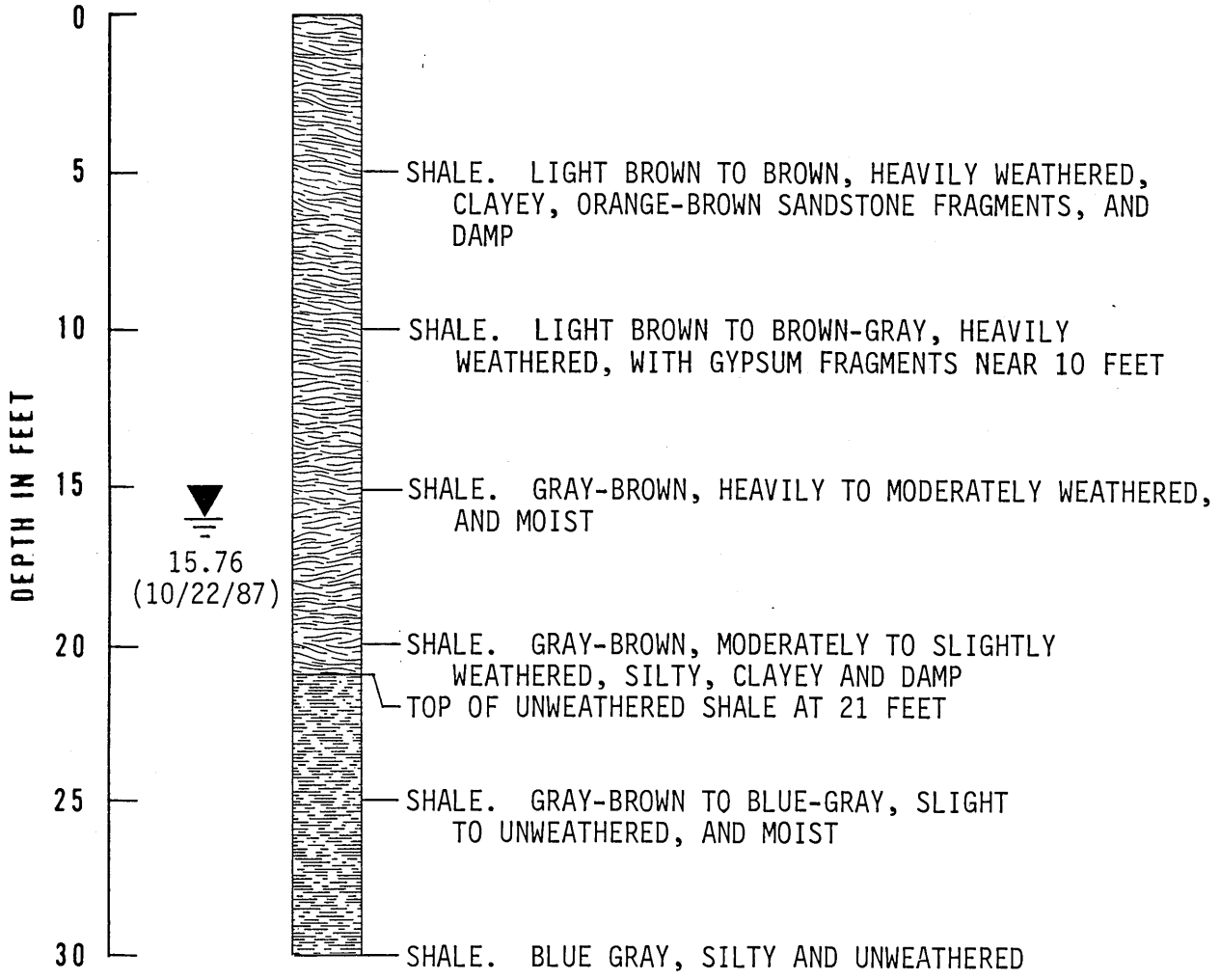



BORING TERMINATED AT 40 FEET ON 9/3/87.

## BORING MW-20

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5150.95 FT.**
**MEASURING POINT** **5153.05 FT.**

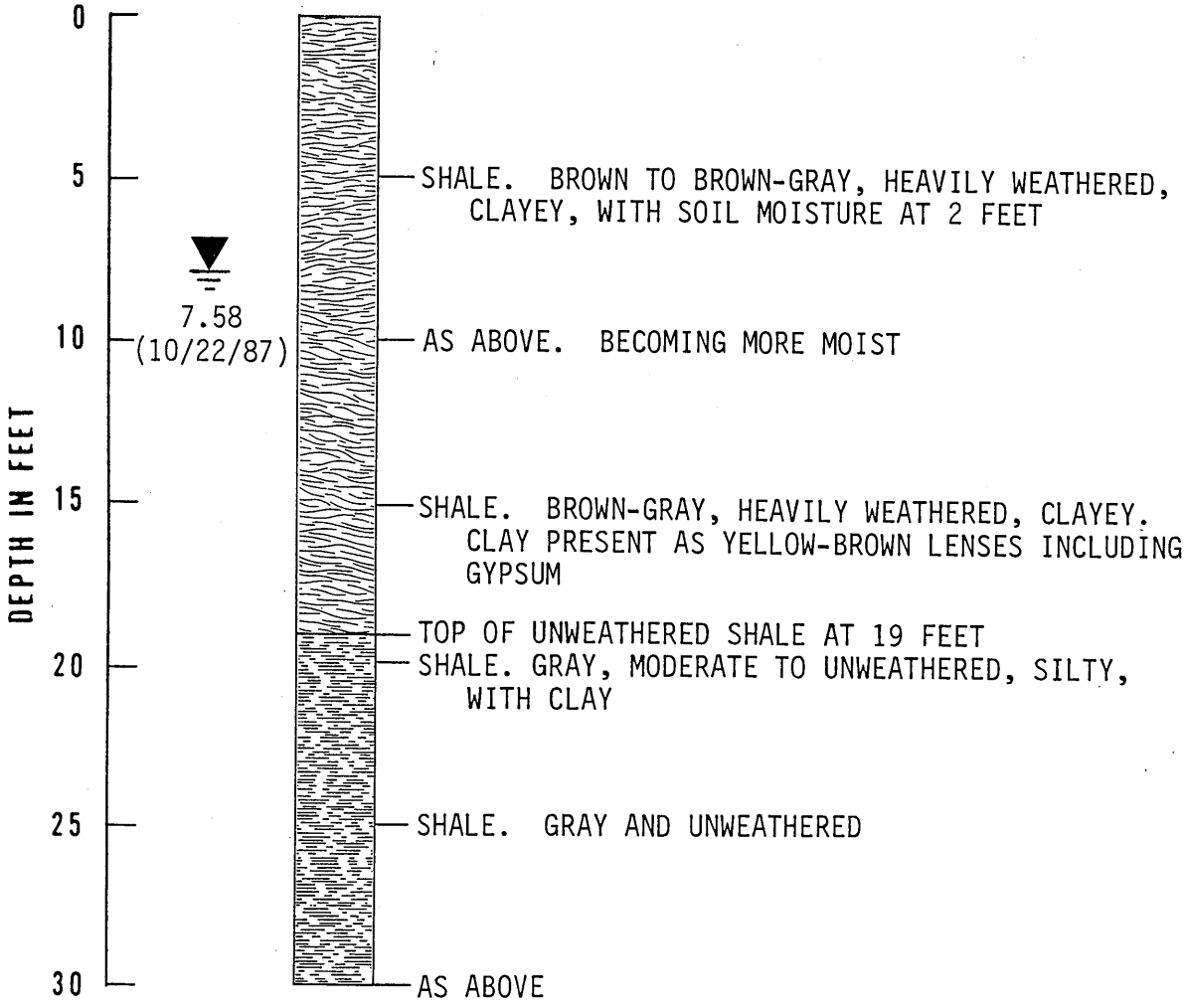



BORING TERMINATED AT 30 FEET ON 9/4/87.

## BORING MW-21

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5152.38 FT.**
**MEASURING POINT** **5154.48 FT.**

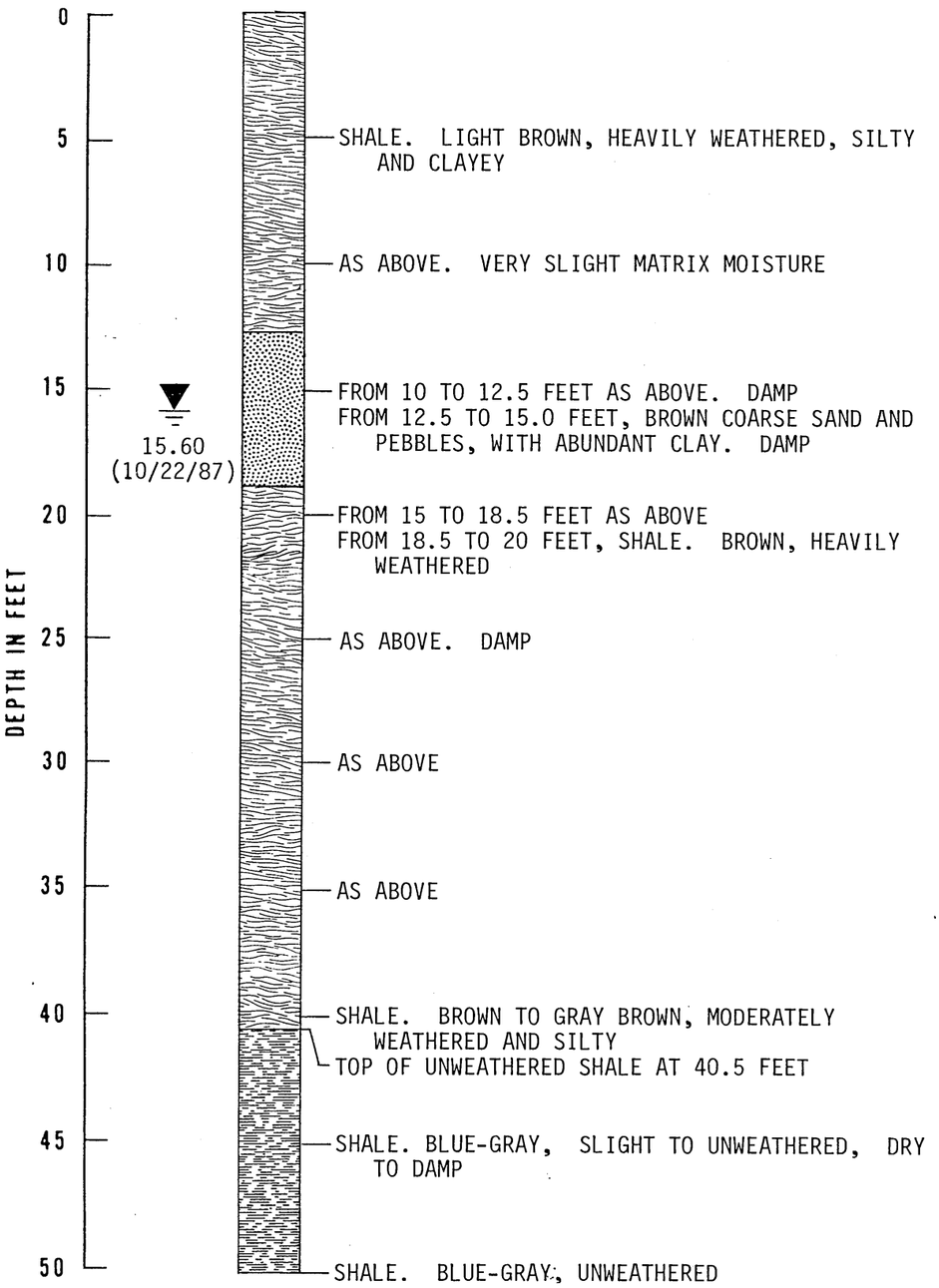



BORING TERMINATED AT 30 FEET ON 9/4/87.

## BORING MW-22

## LITHOLOGIC LOG

**SURFACE ELEVATION** **5094.56 FT.**
**MEASURING POINT** **5096.66 FT.**

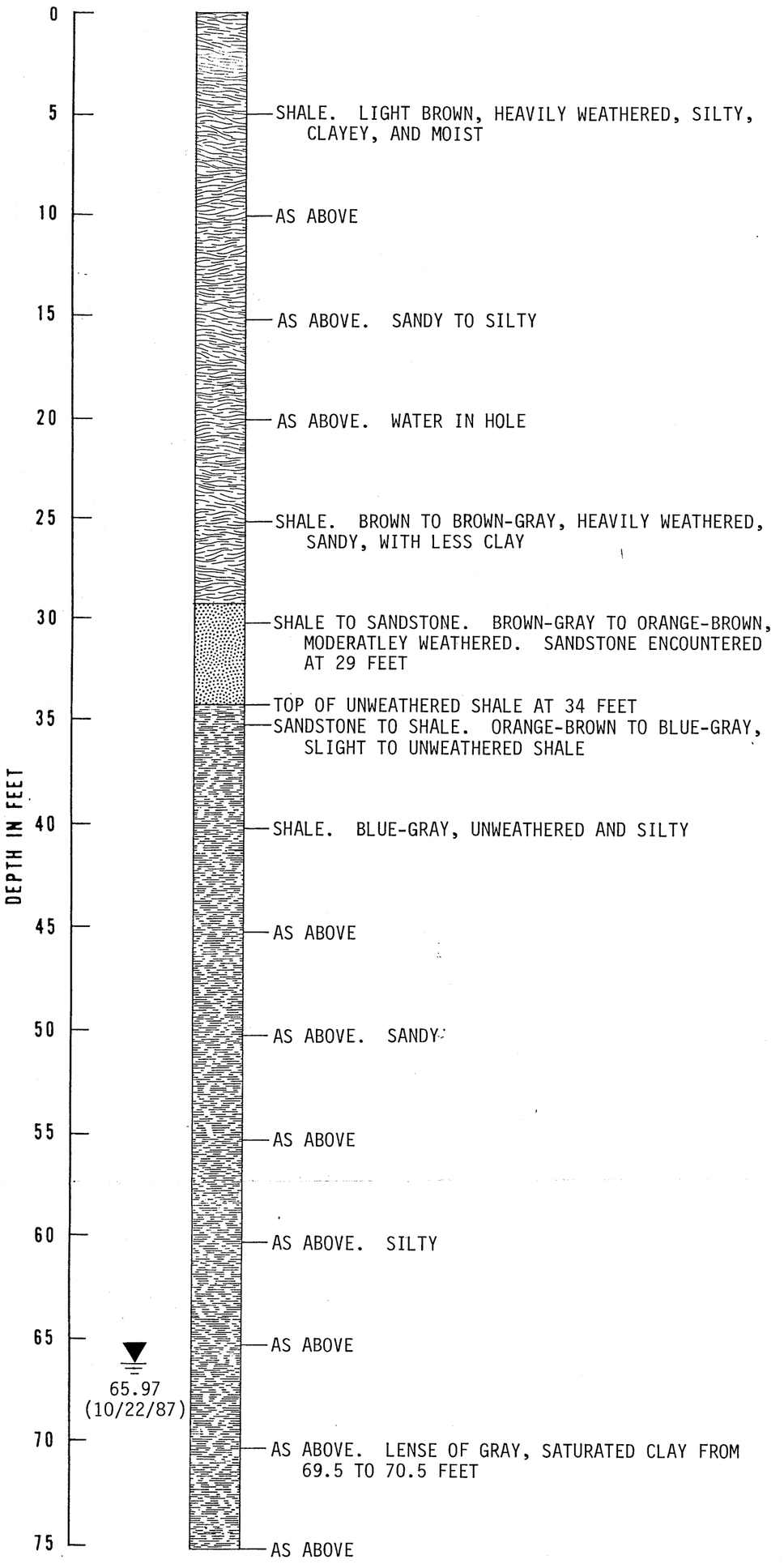



BORING TERMINATED AT 50 FEET ON 9/4/87.

BORING MW-23

## LITHOLOGIC LOG

**SURFACE ELEVATION** **5078.02 FT.**
**MEASURING POINT** **5079.89 FT.**

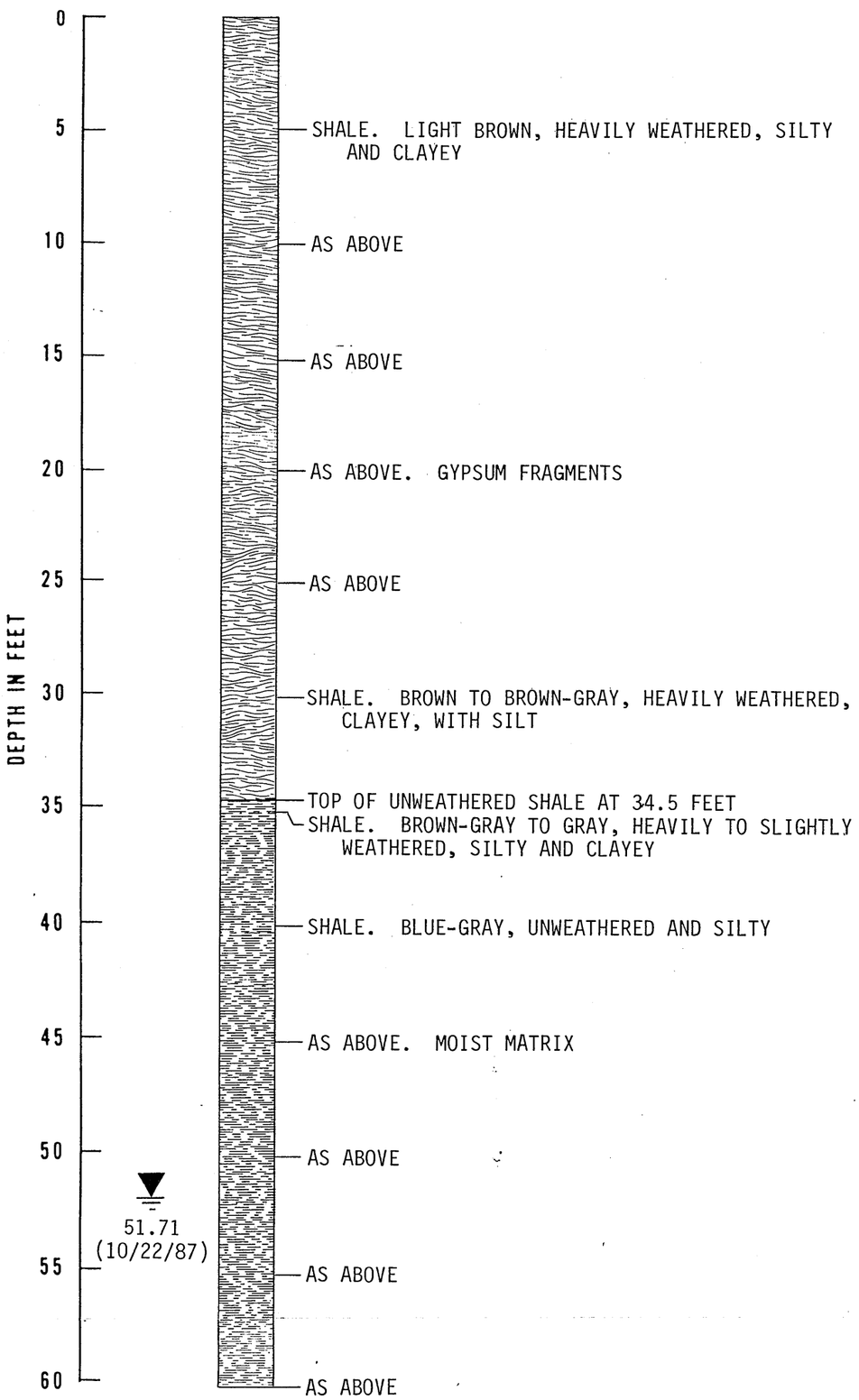



BORING TERMINATED AT 75 FEET ON 9/5/87.

BORING MW-24

## LITHOLOGIC LOG

**SURFACE ELEVATION** **5119.50 FT.**
**MEASURING POINT** **5121.55 FT.**

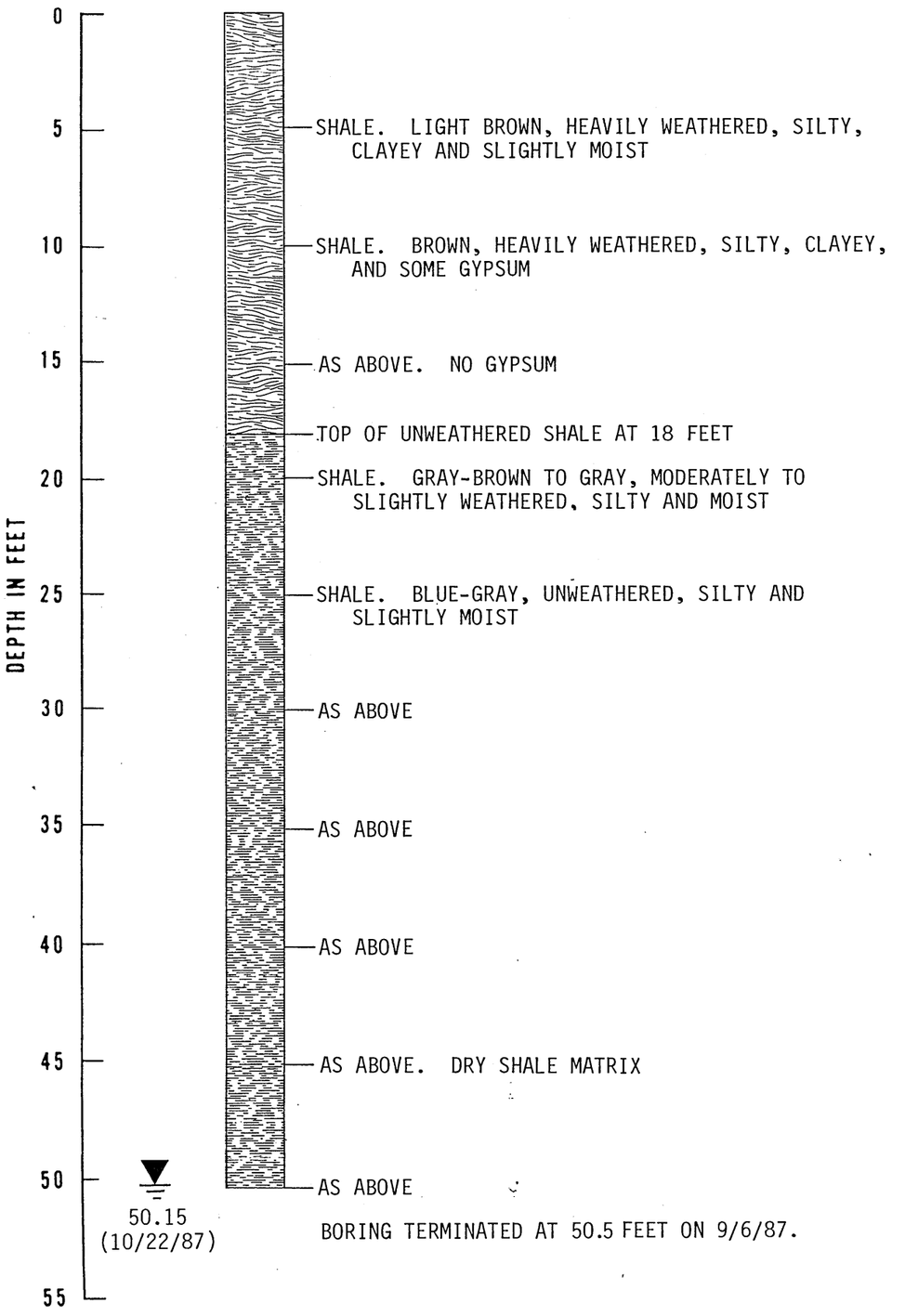



BORING TERMINATED AT 60 FEET ON 9/5/87.

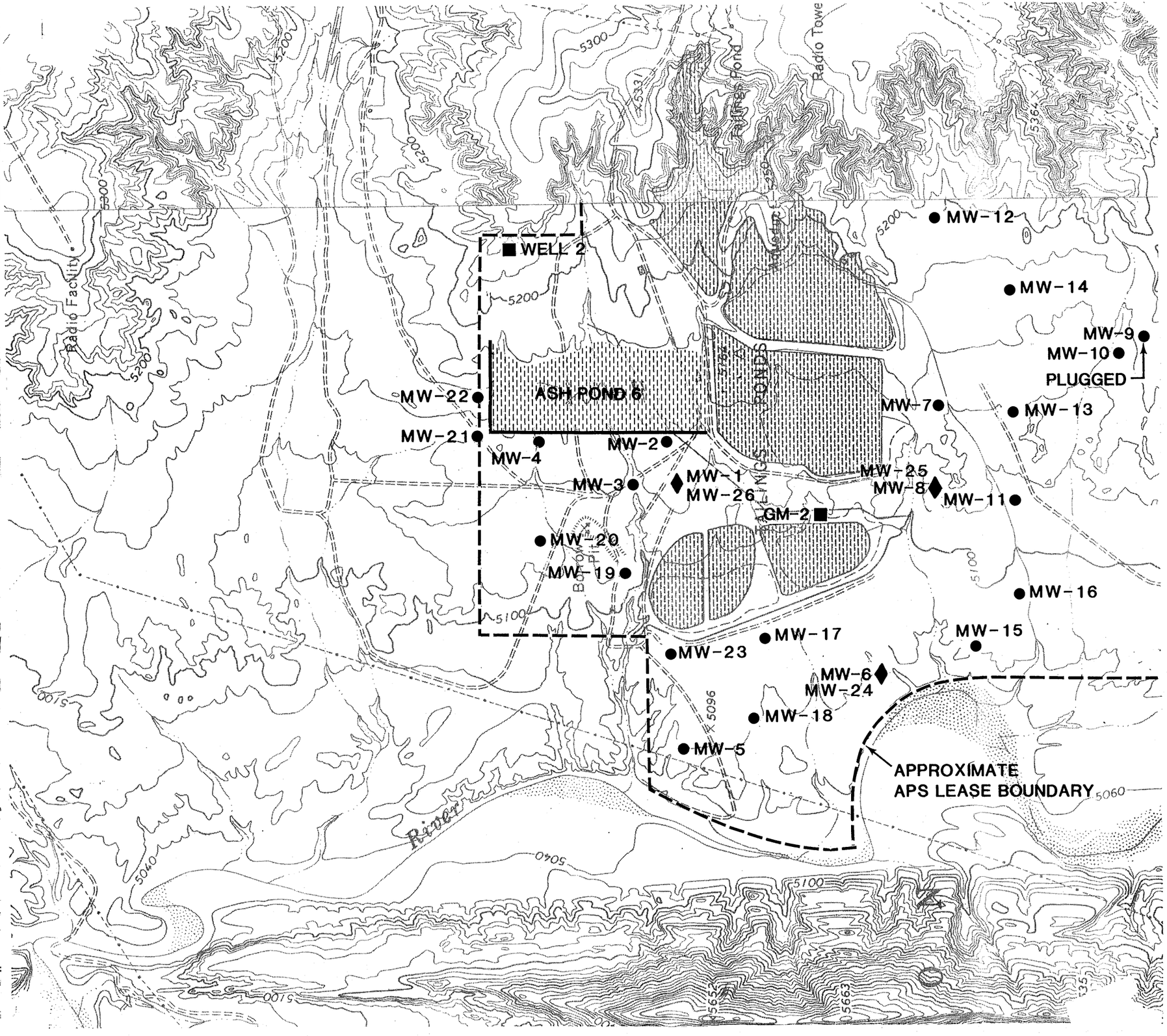
BORING MW-25

# LITHOLOGIC LOG

**SURFACE ELEVATION** **5137.05 FT.**
**MEASURING POINT** **5138.85 FT.**




BORING MW-26




NOTE: CONTOUR INTERVAL 20 FEET

# MONITOR WELL LOCATION MAP

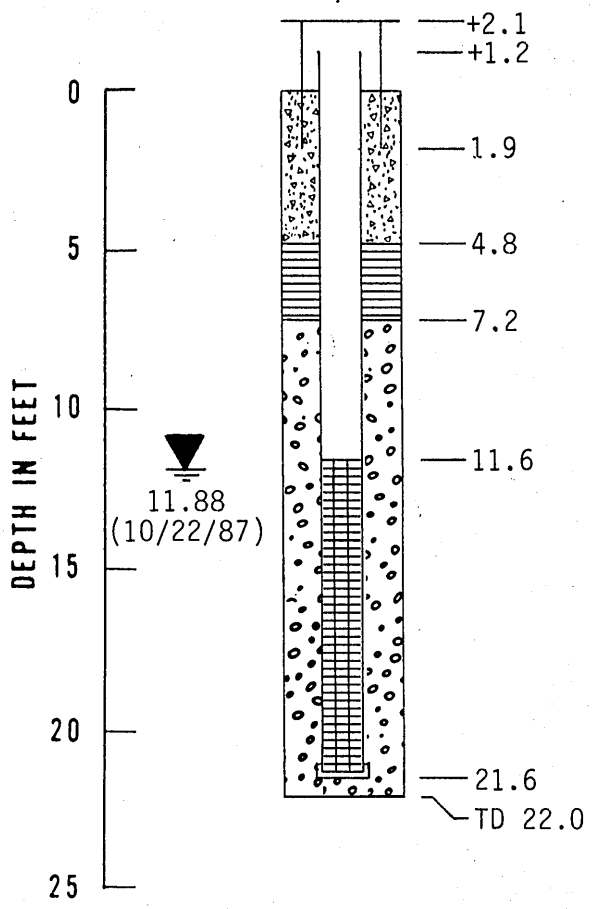
Figure 1

# APPENDIX

## WELL COMPLETION LOGS

# WELL COMPLETION LOG

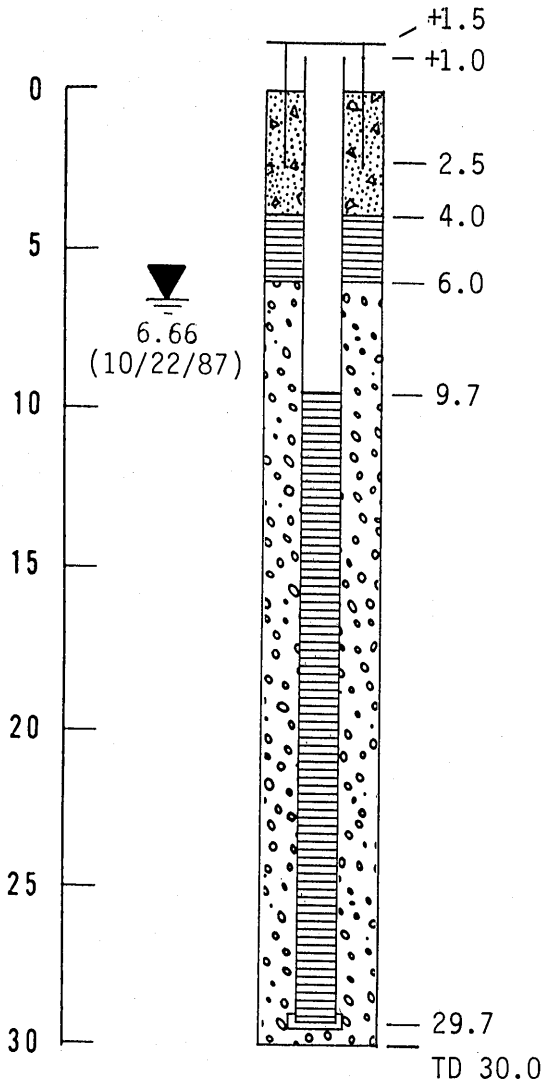
**SURFACE ELEVATION** 5137.05(e) FT.
**MEASURING POINT** 5138.85(e) FT.




## BORING MW-1

# WELL COMPLETION LOG

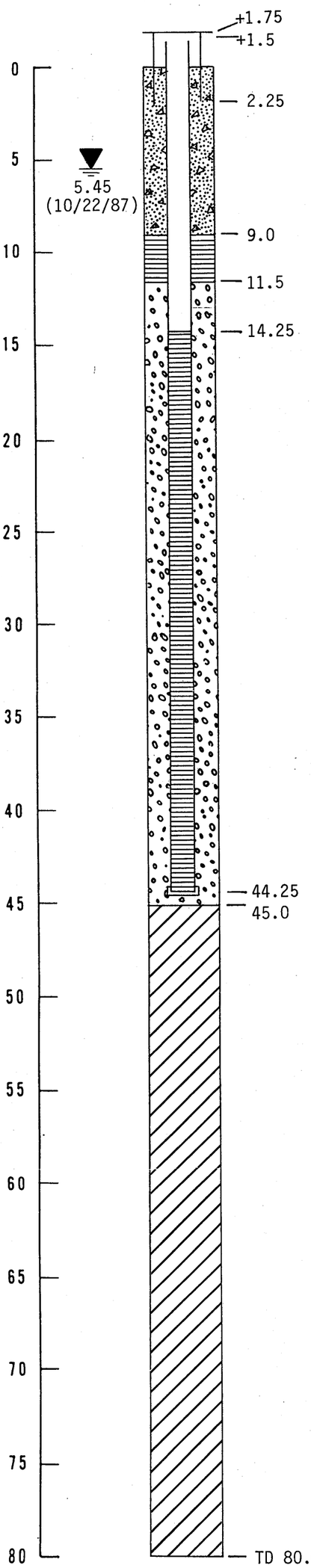
**SURFACE ELEVATION 5147.93 FT.**
**MEASURING POINT 5149.43 FT.**




BORING MW-2

## WELL COMPLETION LOG

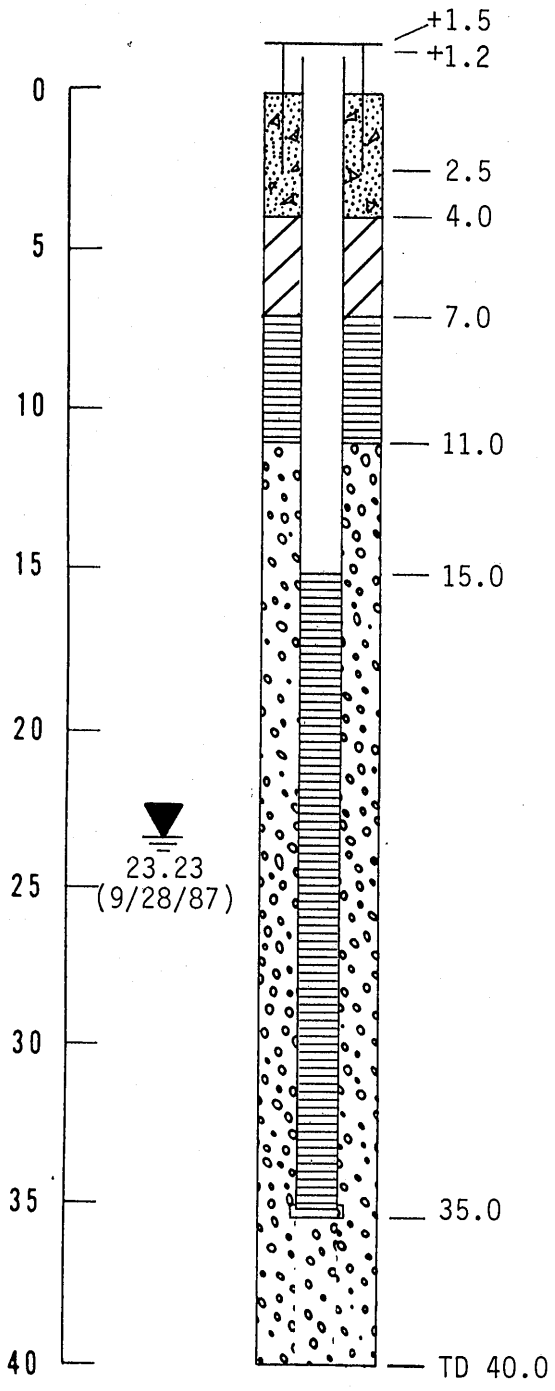
**SURFACE ELEVATION 5124.06 FT.**
**MEASURING POINT 5125.81 FT.**




BORING MW-3

# WELL COMPLETION LOG

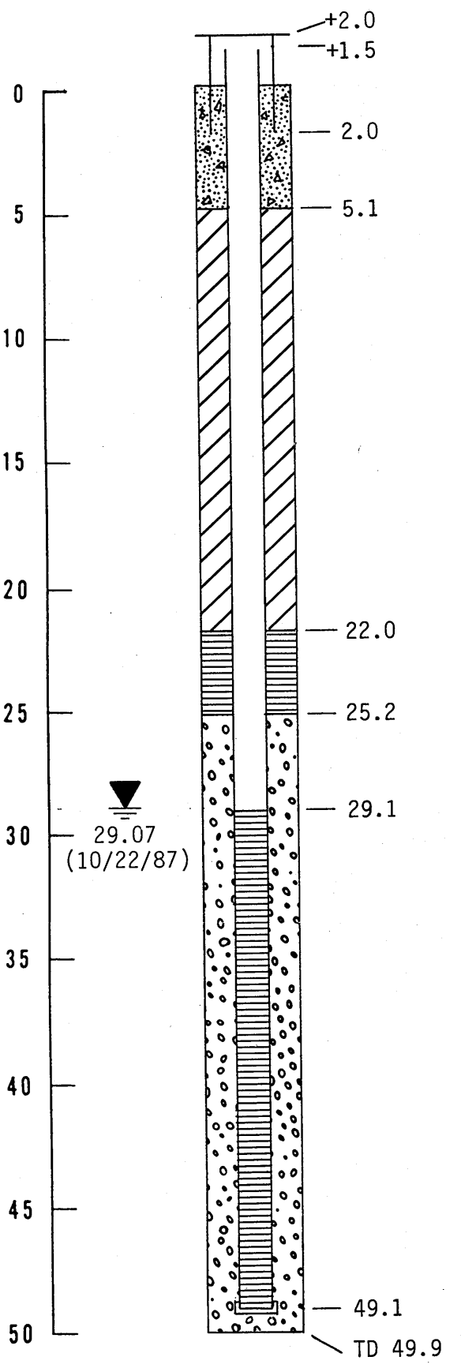
**SURFACE ELEVATION 5146.38 FT.**
**MEASURING POINT 5147.88 FT.**




## BORING MW-4

## WELL COMPLETION LOG

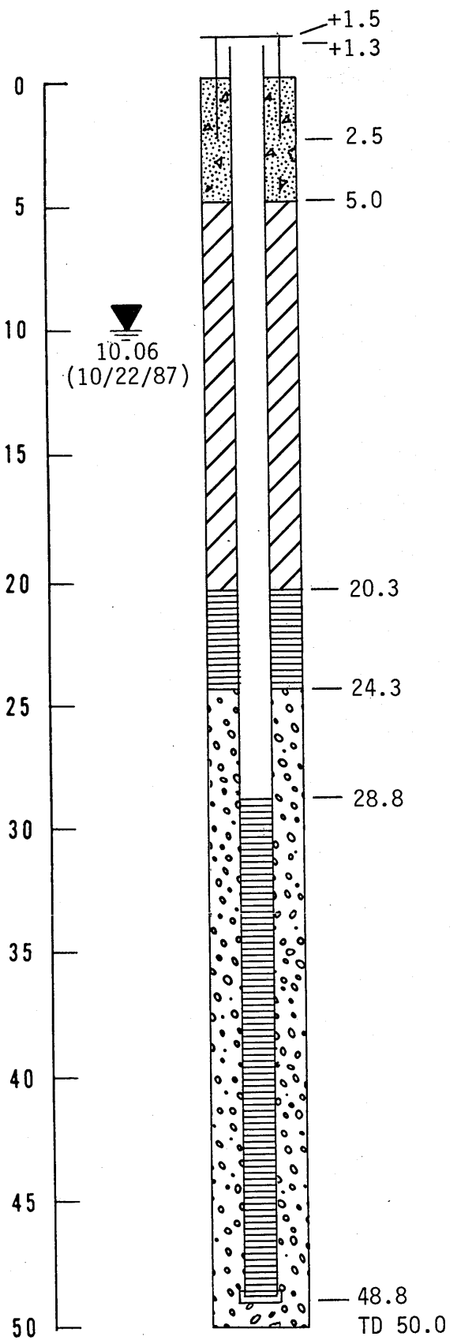
**SURFACE ELEVATION 5084.45 FT.**
**MEASURING POINT 5086.45 FT.**




BORING MW-5

## WELL COMPLETION LOG

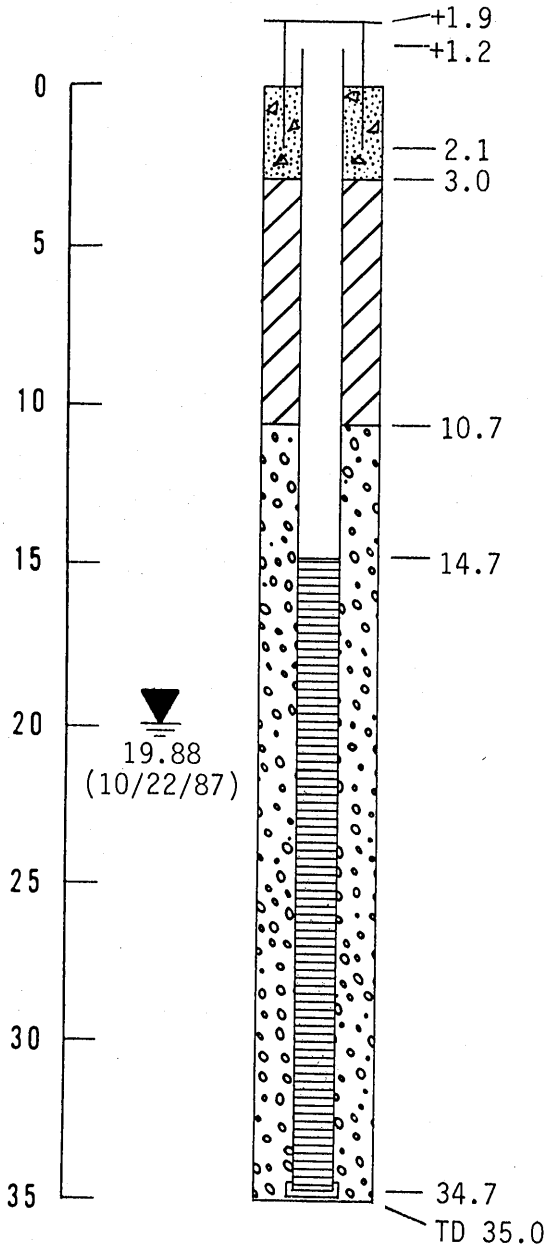
**SURFACE ELEVATION 5078.20 FT.**
**MEASURING POINT 5079.70 FT.**




BORING MW-6

# WELL COMPLETION LOG

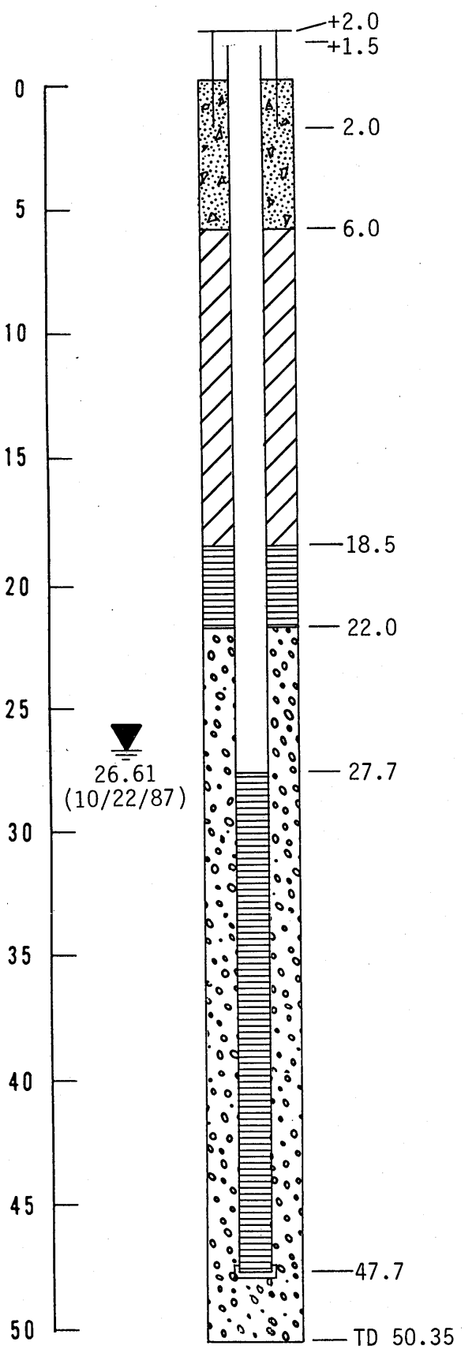
**SURFACE ELEVATION 5146.62 FT.**
**MEASURING POINT 5148.52 FT.**




## BORING MW-7

## WELL COMPLETION LOG

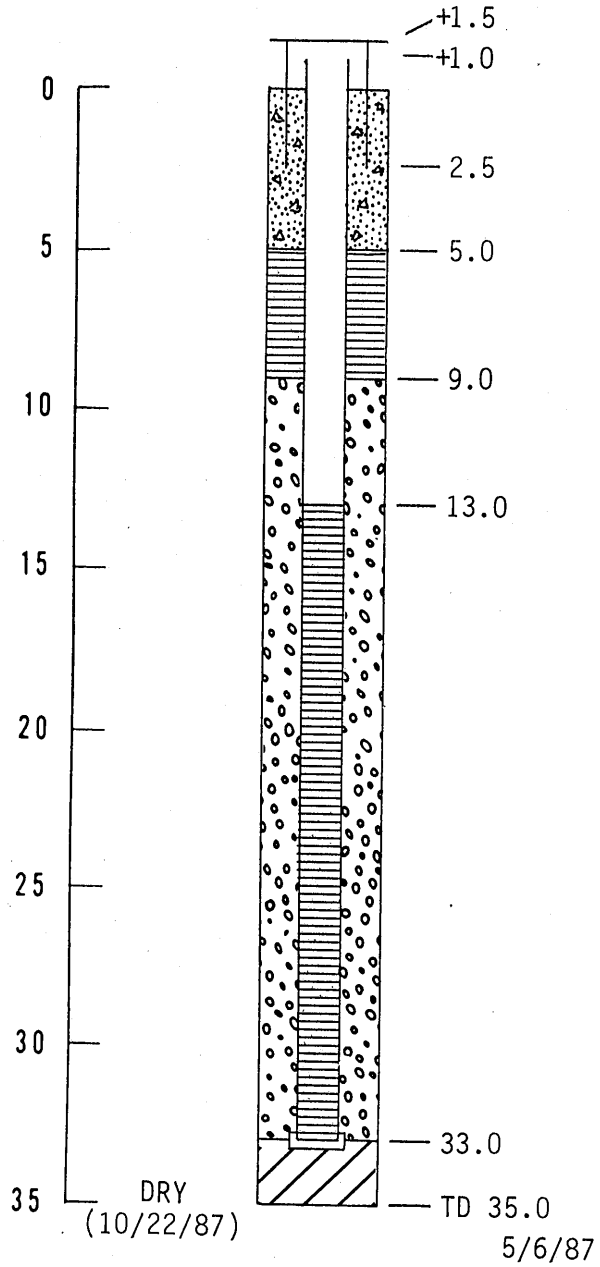
**SURFACE ELEVATION 5118.95 FT.**
**MEASURING POINT 5120.95 FT.**




BORING MW-8

# WELL COMPLETION LOG

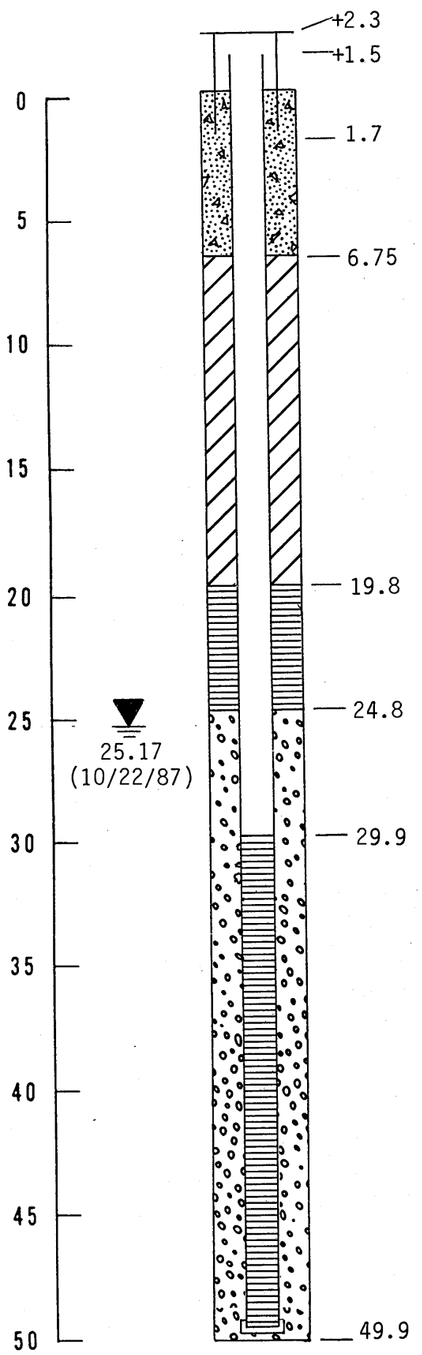
**SURFACE ELEVATION 5147.38 FT.**
**MEASURING POINT 5148.88 FT.**




## BORING MW-10

## WELL COMPLETION LOG

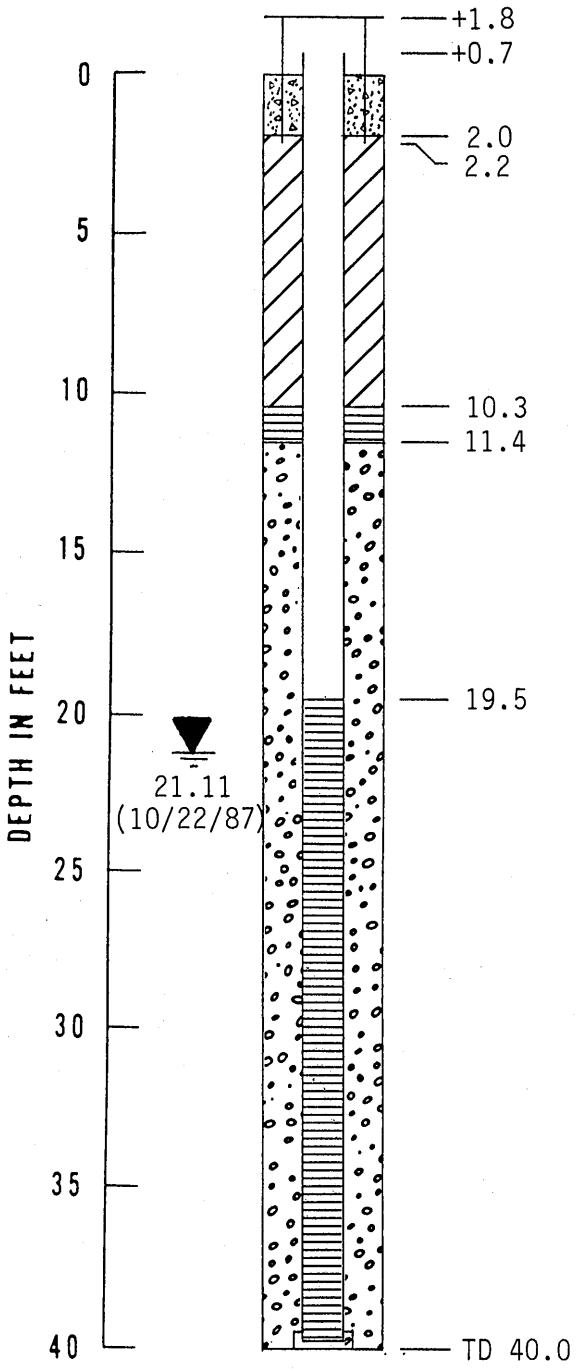
**SURFACE ELEVATION 5109.01 FT.**
**MEASURING POINT 5111.31 FT.**




BORING MW-11

# WELL COMPLETION LOG

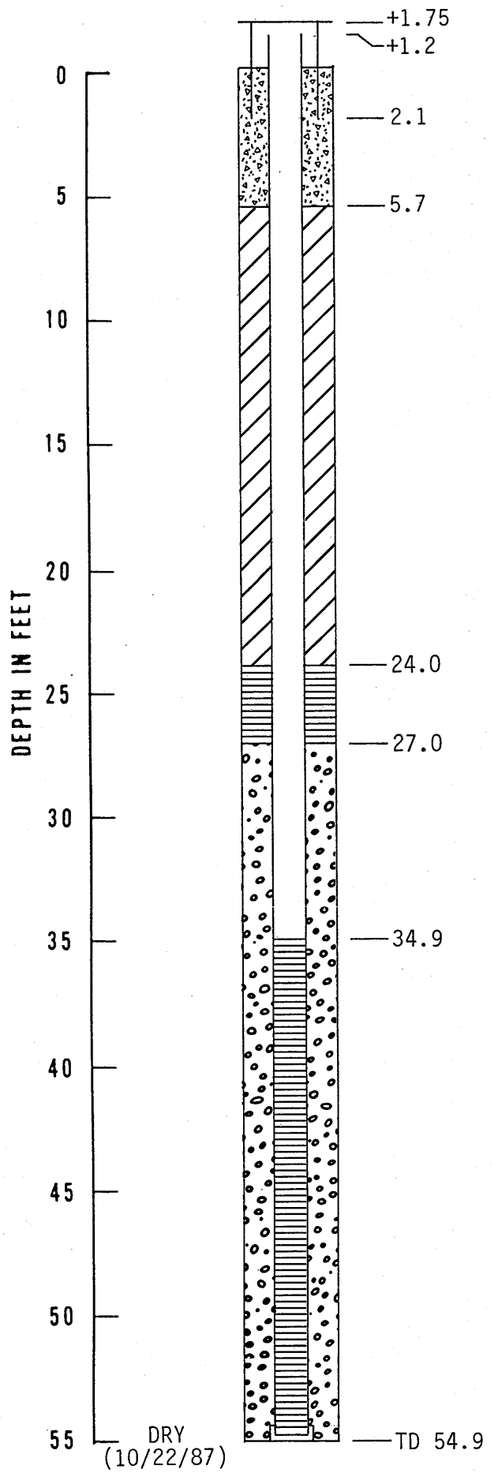
**SURFACE ELEVATION 5196.63 FT.**
**MEASURING POINT 5198.43 FT.**




## BORING MW-12

## WELL COMPLETION LOG

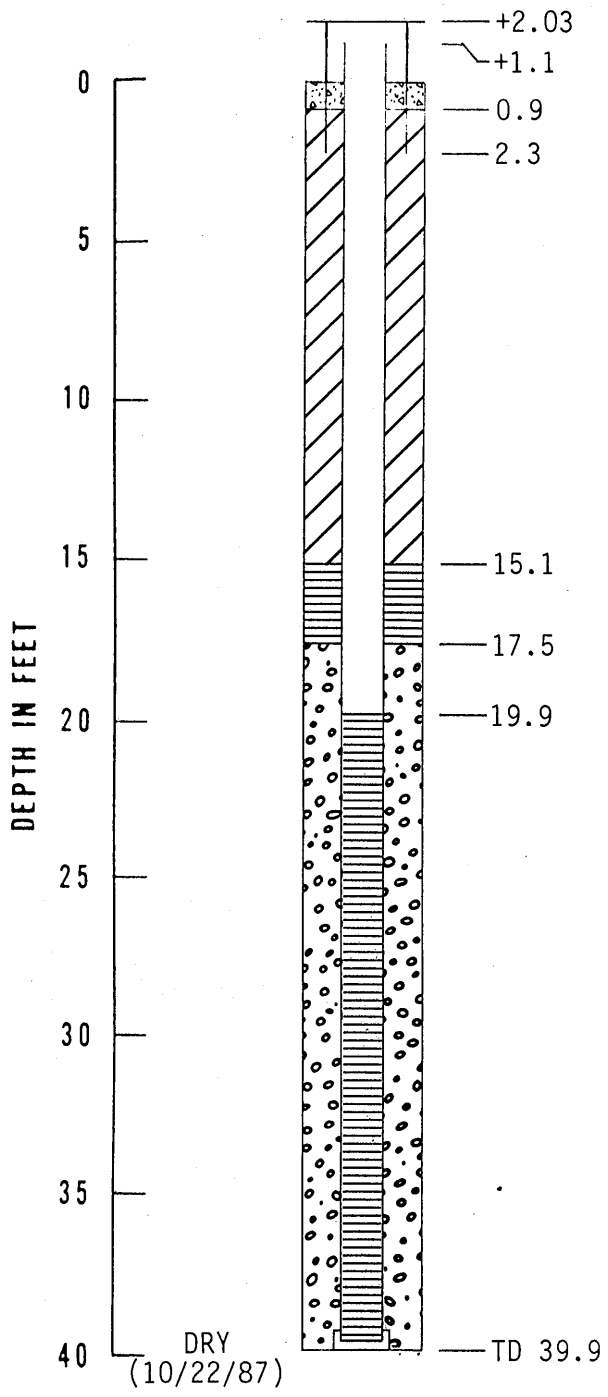
**SURFACE ELEVATION 5147.39 FT.**
**MEASURING POINT 5149.14 FT.**




BORING MW-13

# WELL COMPLETION LOG

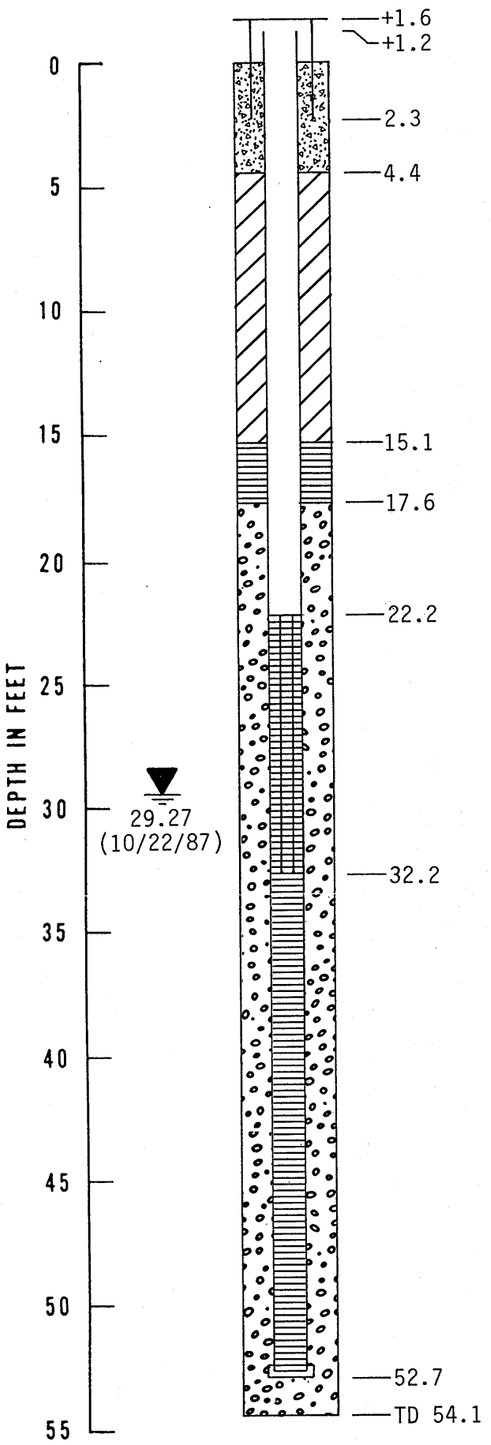
**SURFACE ELEVATION 5177.28 FT.**
**MEASURING POINT 5179.31 FT.**




## BORING MW-14

## WELL COMPLETION LOG

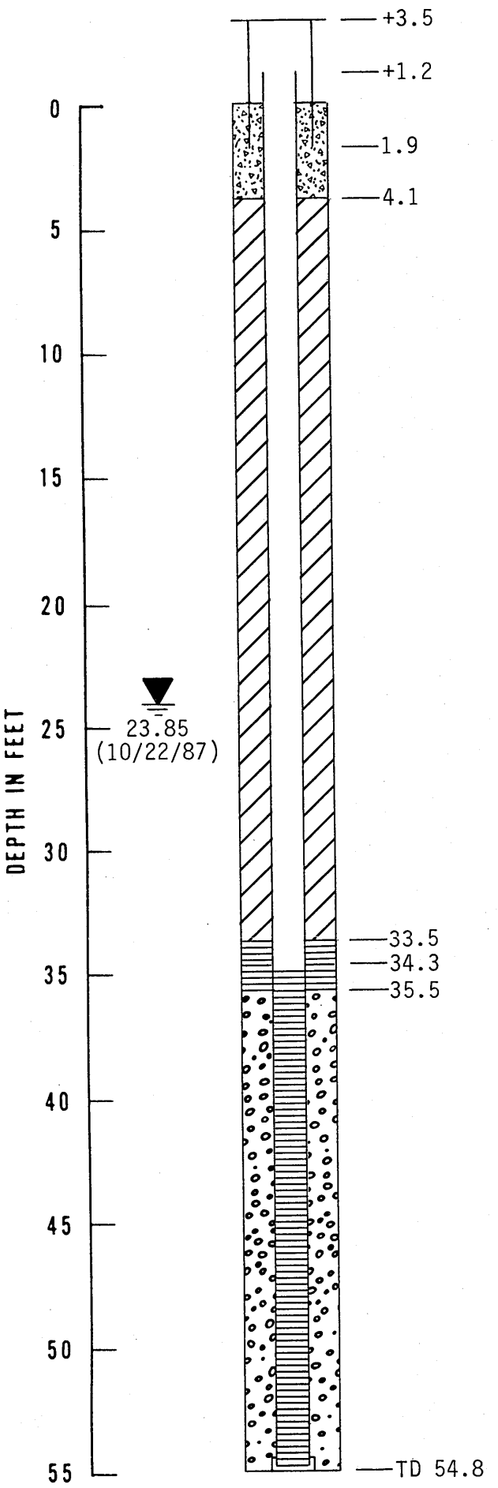
**SURFACE ELEVATION 5089.86 FT.**
**MEASURING POINT 5091.46 FT.**




BORING MW-15

## WELL COMPLETION LOG

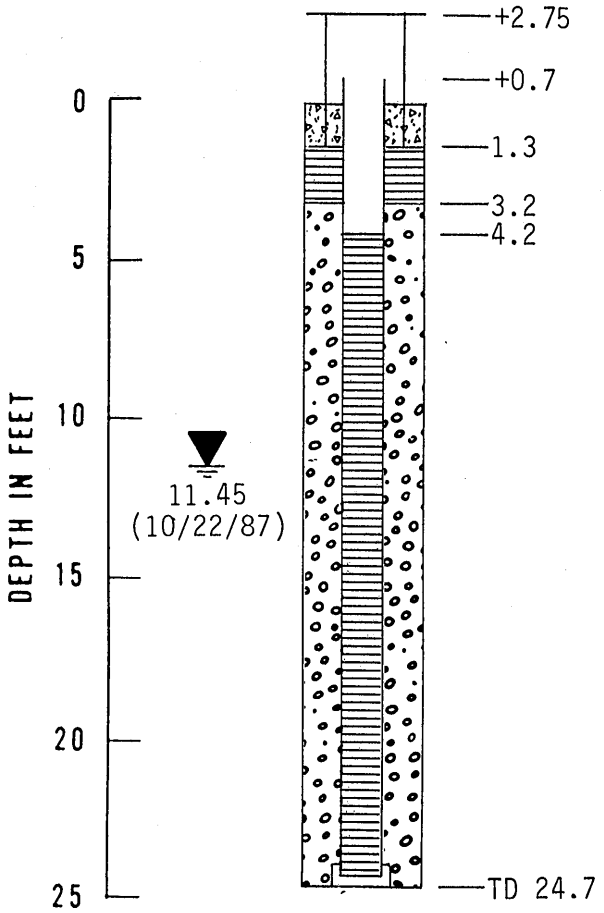
**SURFACE ELEVATION 5096.44 FT.**
**MEASURING POINT 5099.94 FT.**




BORING MW-16

# WELL COMPLETION LOG

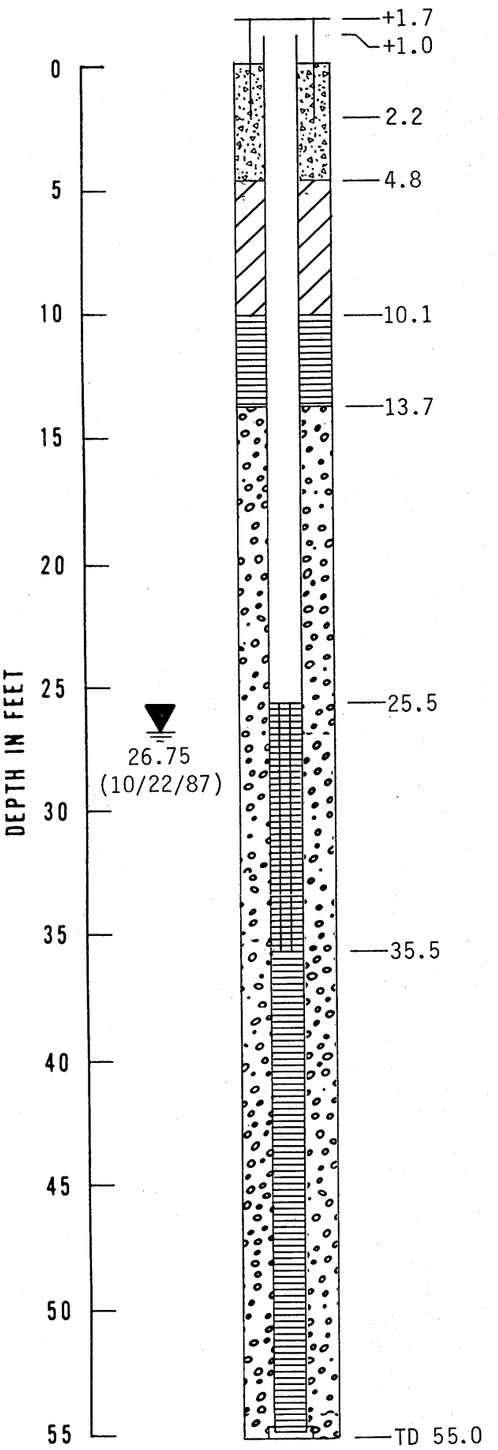
SURFACE ELEVATION 5092.03 FT.
MEASURING POINT 5094.78 FT.




BORING MW-17

## WELL COMPLETION LOG

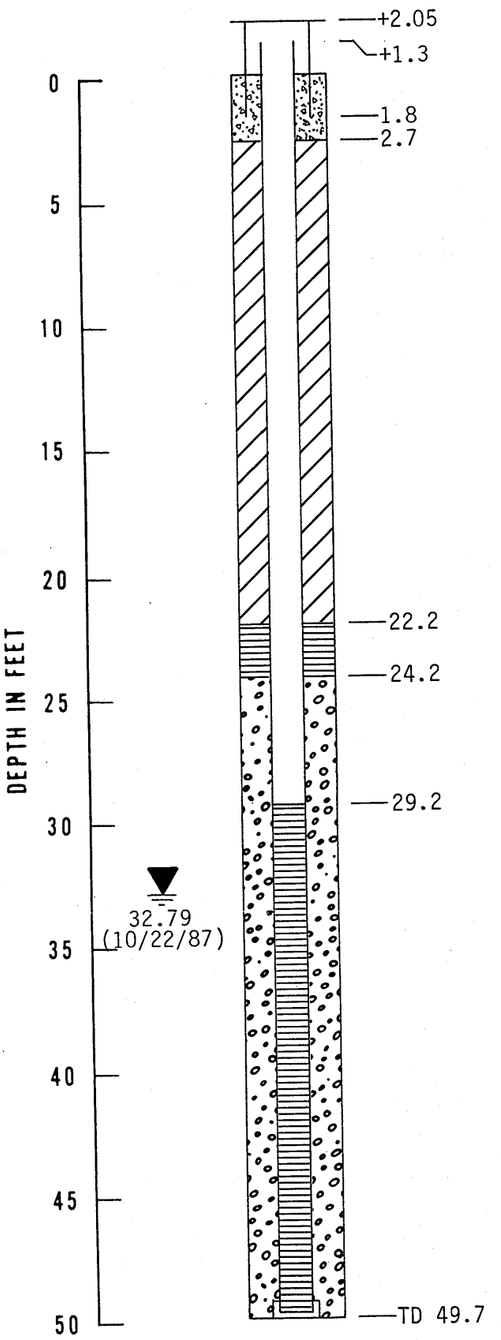
**SURFACE ELEVATION 5085.78 FT.**
**MEASURING POINT 5087.48 FT.**




BORING MW-18

## WELL COMPLETION LOG

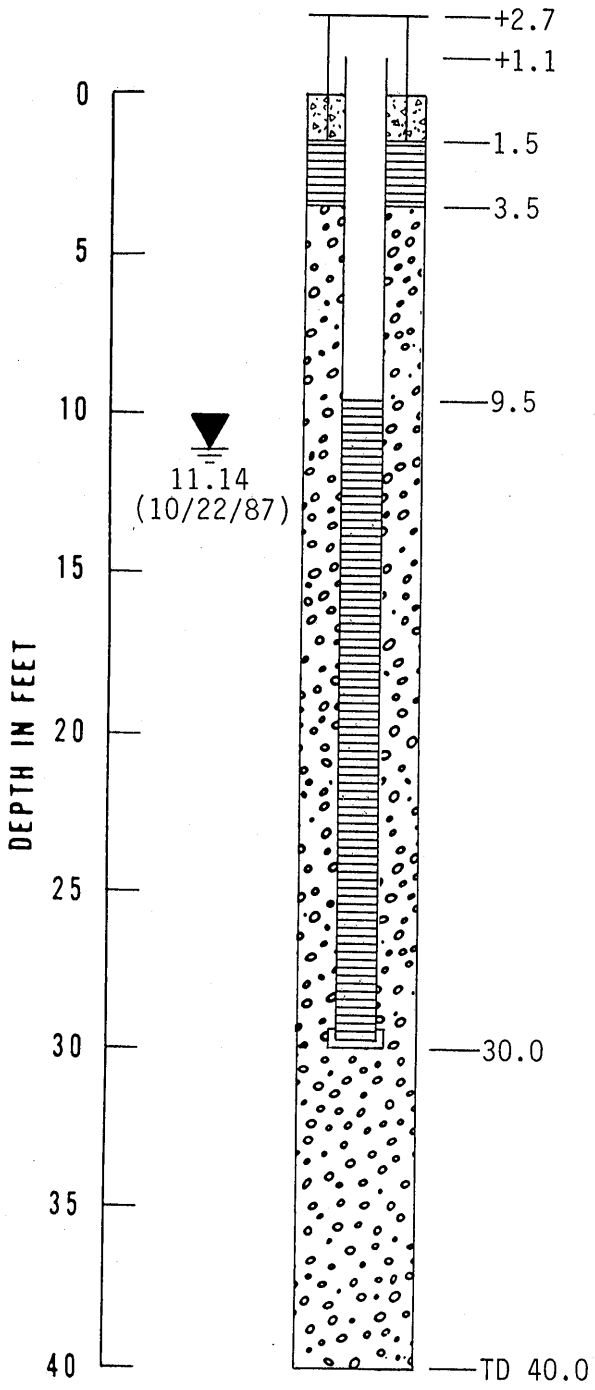
**SURFACE ELEVATION** **5123.73 FT.**
**MEASURING POINT** **5125.78 FT.**




BORING MW-19

# WELL COMPLETION LOG

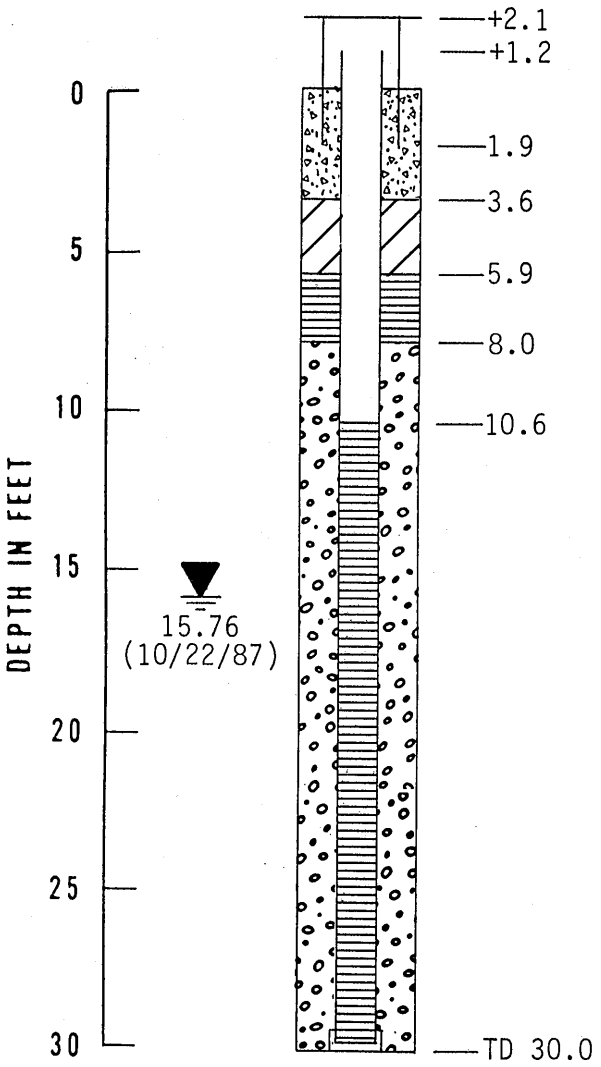
SURFACE ELEVATION 5125.63 FT.
MEASURING POINT 5128.33 FT.




BORING MW-20

# WELL COMPLETION LOG

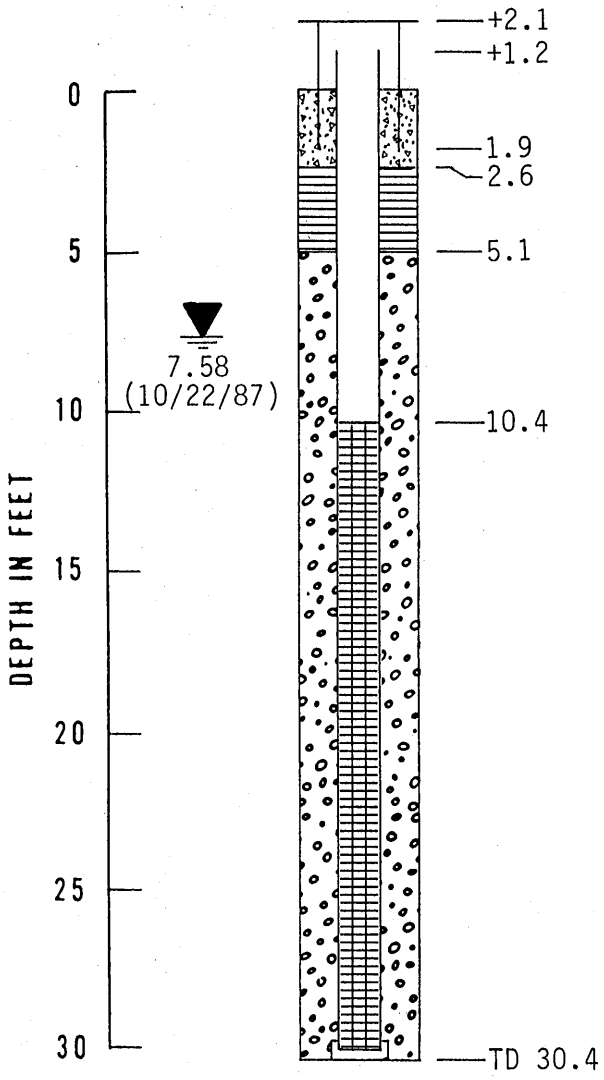
**SURFACE ELEVATION** 5150.95 FT.
**MEASURING POINT** 5153.05 FT.




## BORING MW-21

# WELL COMPLETION LOG

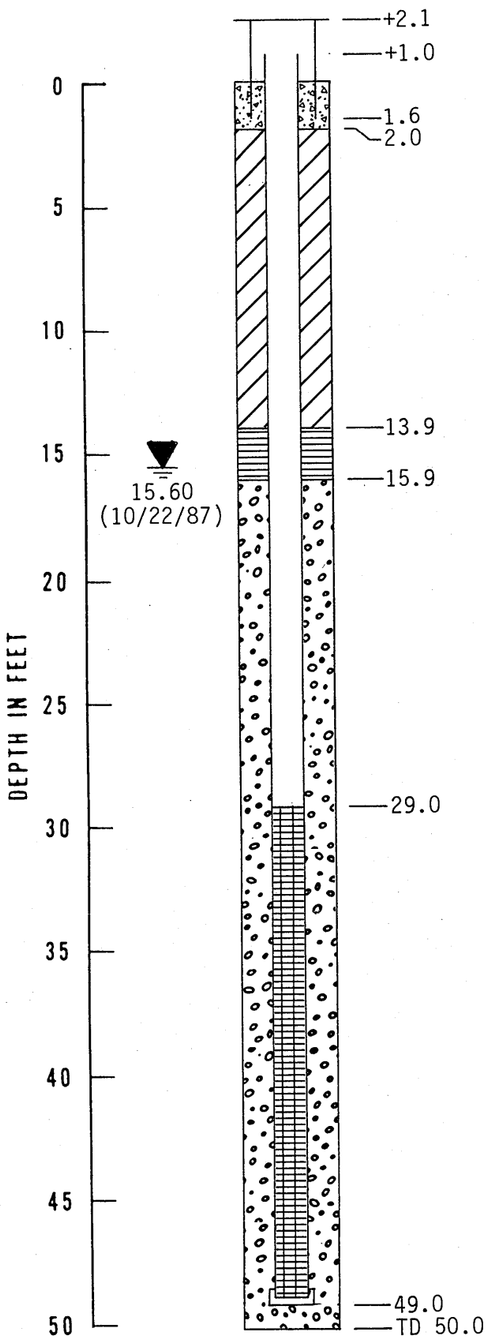
**SURFACE ELEVATION 5152.38 FT.**
**MEASURING POINT 5154.48 FT.**




## BORING MW-22

## WELL COMPLETION LOG

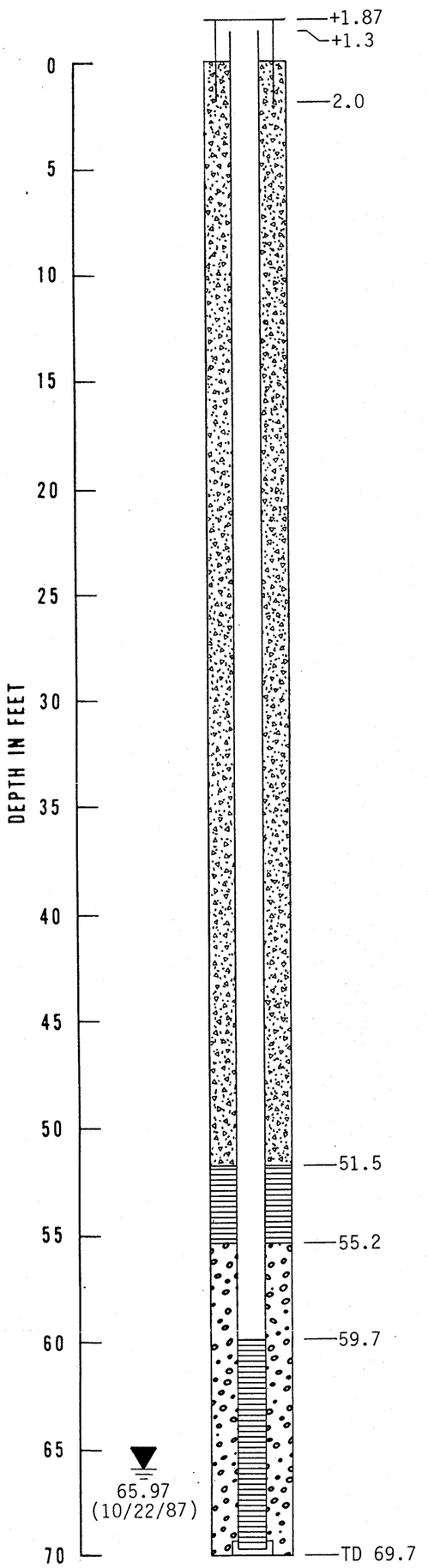
**SURFACE ELEVATION 5094.56 FT.**
**MEASURING POINT 5096.66 FT.**




BORING MW-23

## WELL COMPLETION LOG

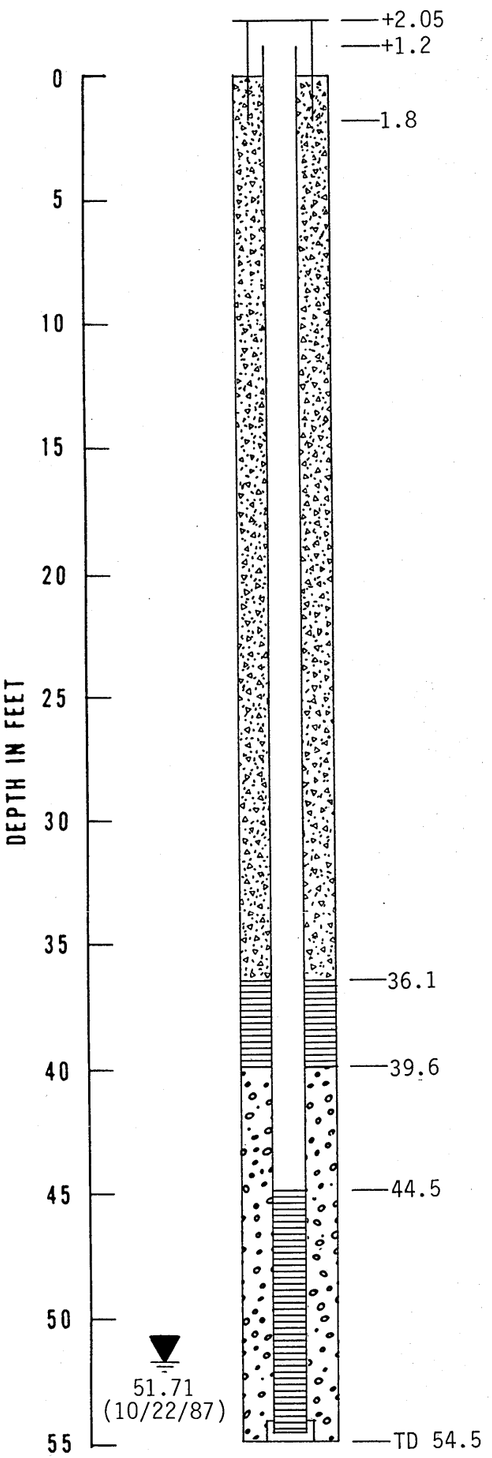
**SURFACE ELEVATION 5078.02 FT.**
**MEASURING POINT 5079.89 FT.**




BORING MW-24

## WELL COMPLETION LOG

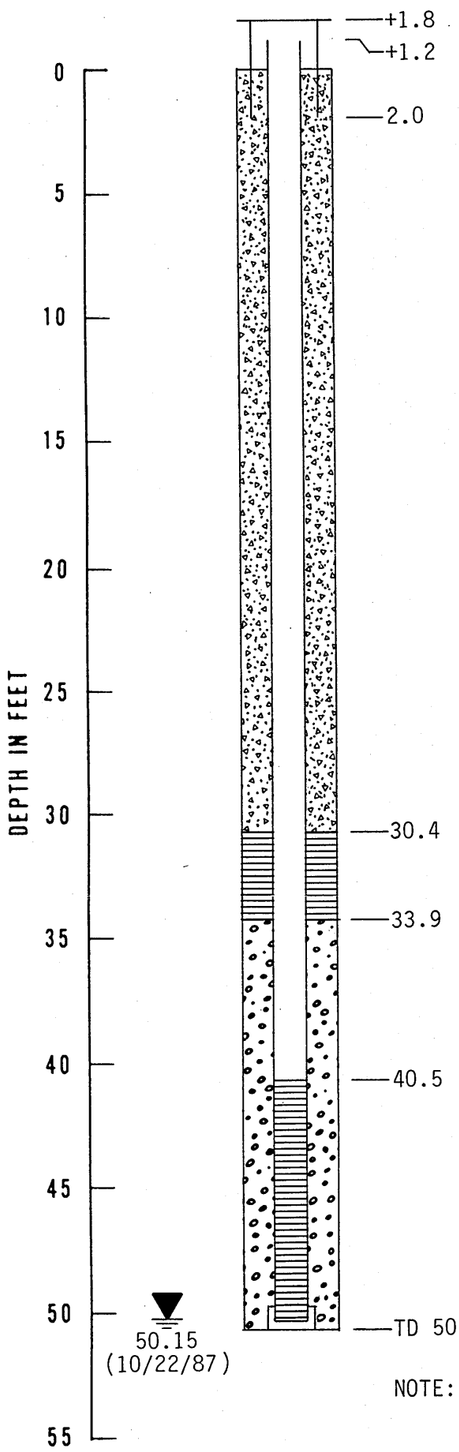
**SURFACE ELEVATION 5119.50 FT.**
**MEASURING POINT 5121.55 FT.**




BORING MW-25

## WELL COMPLETION LOG

**SURFACE ELEVATION 5137.05 FT.**
**MEASURING POINT 5138.85 FT.**




NOTE: WELL SCREEN IS HAND SLOTTED
SEE TEXT FOR DESCRIPTION.

BORING MW-26

# BORING DMX-1

SURFACE ELEVATION: 5097.7
N2071750
E299030

| SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|
| | SC | BROWN FINE SAND WITH CLAY |
| | | INCREASED CLAY CONTENT |
| | GW | BROWN WELL GRADED GRAVEL WITH A TRACE OF FINE SAND (PARTICLES TO PEA SIZE) |
| | | BROWN HEAVILY WEATHERED SHALE |
| | | DARK GREY UNWEATHERED SHALE |

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE | ATTERBERG LIMITS: LIQUID LIMIT (%) | ATTERBERG LIMITS: PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | 0 | | | | | | |
| | | 5 | | | | | | |
| | | 10 | | | | | | |
| | | 15 | | | | | | |
| | | 20 | | | | | | |
| | | 25 | | | | | | |
| | | 30 | | | | | | |
| | | 35 | | | | | | |
| | | 40 | | | | | | |
| | | 45 | | | | | | |
| | | 50 | | | | | | |
| | | 55 | | | | | | |
| | | 60 | | | | | | |
| | | 65 | | | | | | |
| | | 70 | | | | | | |
| | | 75 | | | | | | |
| | | 80 | | | | | | |

NOTES:
BORING TERMINATED AT 45 FEET ON 4/15/92.
MONITORING WELL INSTALLED, SEE PLATE 18
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

## LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A11

# BORING DMX-2

SURFACE ELEVATION: 5094.8
N2071030
E299060

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | TESTS REPORTED ELSEWHERE | LABORATORY TEST DATA: ATTERBERG LIMITS — LIQUID LIMIT (%) | ATTERBERG LIMITS — PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80

SAMPLES

| SYMBOLS | DESCRIPTION |
|---|---|
| SC | BROWN FINE SAND WITH CLAY |
| | BROWN HEAVILY WEATHERED SHALE |
| GW | BROWN WELL GRADED GRAVELS WITH TRACE OF FINE SAND (PARTICLES TO PEA SIZE) |
| | BROWN HEAVILY WEATHERED SHALE |
| | DARK GREY UNWEATHERED SHALE |

NOTES:
BORING TERMINATED AT 55 FEET ON 4/14/92.
MONITORING WELL INSTALLED. SEE PLATE 19
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

## LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A12

# BORING DMX-3

SURFACE ELEVATION: 5082.5
N2070815
E298360

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE | ATTERBERG LIMITS: LIQUID LIMIT (%) | ATTERBERG LIMITS: PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80

SAMPLES

| SYMBOLS | | DESCRIPTION |
|---|---|---|
| | SC | BROWN FINE SAND WITH CLAY |
| | GW | BROWN WELL GRADED GRAVELS WITH TRACE OF FINE SAND (PARTICLES TO PEA SIZE) |
| | | BROWN HEAVILY WEATHERED SHALE |
| | | DARK GREY UNWEATHERED SHALE |

NOTES:
BORING TERMINATED AT 45 FEET ON 4/14/92.
MONITORING WELL INSTALLED. SEE PLATE 20
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

## LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A13

# BORING DMX-4

SURFACE ELEVATION: 5069.8
N2068350
E297860

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE | ATTERBERG LIMITS: LIQUID LIMIT (%) | ATTERBERG LIMITS: PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80

SAMPLES

| SYMBOLS | DESCRIPTION |
|---|---|
| SC | BROWN FINE SAND WITH CLAY |
| | BROWN HEAVILY WEATHERED SHALE |
| GW | BROWN WELL GRADED GRAVELS WITH TRACE OF FINE SAND (PARTICLES TO PEA SIZE) |
| | DARK GREY UNWEATERED SHALE |

NOTES:
BORING TERMINATED AT 60 FEET ON 4/15/92.
MONITOR WELL INSTALLED, SEE PLATE 21
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

# LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A14

# BORING DMX-5

SURFACE ELEVATION: 5079.2
N2067620
E298645

| SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|
| | SC | BROWN FINE SAND WITH CLAY |
| | | INCREASE IN CLAY CONTENT |
| | GW | BROWN WELL GRADED FINE GRAVELS WITH TRACE FINE SAND |
| | | BROWN HEAVILY WEATHERED SHALE |
| | GW | BROWN WELL GRADED GRAVEL WITH TRACE FINE SAND (PARTICLES TO PEA SIZE) |
| | | DARK GREY UNWEATHERED SHALE |

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | TESTS REPORTED ELSEWHERE | LABORATORY TEST DATA: ATTERBERG LIMITS — LIQUID LIMIT (%) | ATTERBERG LIMITS — PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80

NOTES:
BORING TERMINATED AT 60 FEET ON 4/15/92.
MONITOR WELL INSTALLED. SEE PLATE 22
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

## LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A15

# BORING DMX-6

SURFACE ELEVATION: 5074.1
N2067120
E298710

| SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|
| | SC | BROWN FINE SAND WITH CLAY |
| | | DARK GREY UNWEATHERED SHALE |

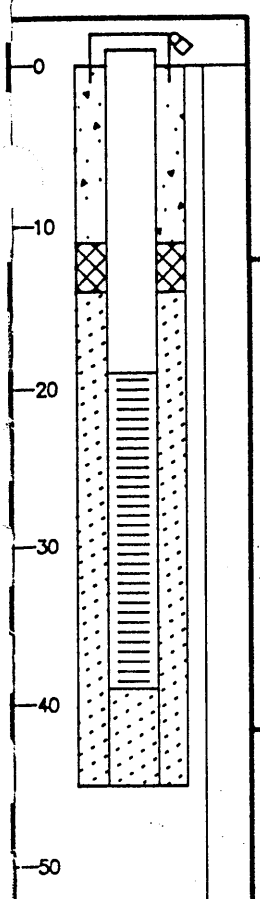
| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | SAMPLE NO. / SAMPLE DEPTH | LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE | ATTERBERG LIMITS: LIQUID LIMIT (%) | ATTERBERG LIMITS: PLASTICITY INDEX (%) | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | SHEAR STRENGTH TX/UU (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | 0 | | | | | | |
| | | 5 | | | | | | |
| | | 10 | | | | | | |
| | | 15 | | | | | | |
| | | 20 | | | | | | |
| | | 25 | | | | | | |
| | | 30 | | | | | | |
| | | 35 | | | | | | |
| | | 40 | | | | | | |
| | | 45 | | | | | | |
| | | 50 | | | | | | |
| | | 55 | | | | | | |
| | | 60 | | | | | | |
| | | 65 | | | | | | |
| | | 70 | | | | | | |
| | | 75 | | | | | | |
| | | 80 | | | | | | |

NOTES:
BORING TERMINATED AT 40 FEET ON 4/16/92.
MONITORING WELL INSTALLED. SEE PLATE 23
GROUNDWATER NOT DISCERNABLE DURING DRILLING.
COORDINATES AND ELEVATION ARE ESTIMATED.
SURVEY DATA TO BE PROVIDED LATER.

## LOG OF BORING

APS FOUR CORNERS
02353-118-022

BY DAMES & MOORE Plate A16




Dames & Moore

Well No. DMX-1

Job No. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2071750 E299030

Elevation Ground Level 5097.7

Top of Casing 5099.2

SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

SUPERVISED BY DAVID GORDON

DATE 4-17-92

## Drilling Summary:

Total Depth 45 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: + 1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-15-92 | 07:40 | 4-15-92 | 08:17 |
| Geophys. Logging: | | | | |
| Casing: | 4-15-92 | 09:30 | 4-15-92 | 09:40 |
| Filter Placement: | 4-15-92 | 09:40 | 4-15-92 | 09:55 |
| Cementing: | 4-15-92 | 10:10 | 4-15-92 | 10:25 |
| Development: | 4-16-92 | 14:45 | 4-16-92 | 15:45 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 19 | C1 | – |
| 19 – 39 | S1 | – |
| – | END CAP | – |
| – | | – |
| – | | – |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: WASHED PEA GRAVEL FROM 45 FEET TO 14 FEET.

Grout Seal: REDI-MIX CEMENT FROM 11 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 14 FEET TO 11 FEET.

## Well Development:

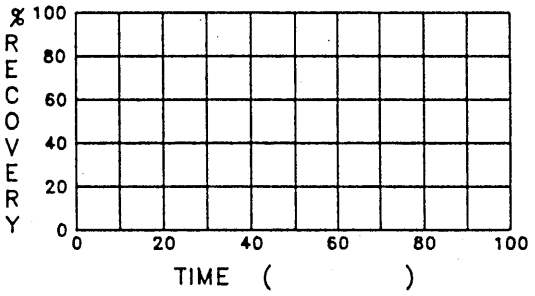
WELL DEVELOPED BY AIR LIFT METHODS ON 4-16-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

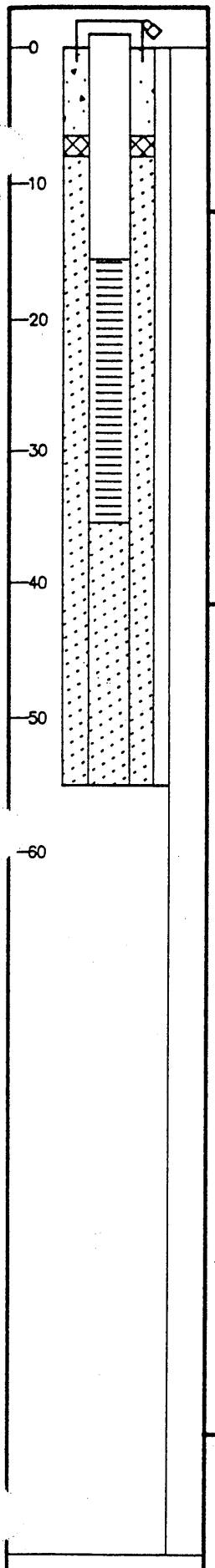
## Recovery Data:

Q= $S_o$=




Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

**Plate A17**




Dames & Moore

Well No. DMX-2

Job No. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2071030 E299060

Elevation Ground Level 5094.8

Top of Casing 5096.0

SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

## Drilling Summary:

Total Depth 55 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: +1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-14-92 | 09:00 | 4-14-92 | 10:00 |
| Geophys. Logging: | | | | |
| Casing: | 4-14-92 | 10:45 | 4-14-92 | 10:55 |
| Filter Placement: | 4-14-92 | 11:05 | 4-14-92 | 16:15 |
| Cementing: | 4-15-92 | 06:45 | 4-15-92 | 07:00 |
| Development: | 4-16-92 | 12:40 | 4-16-92 | 14:40 |
| | 4-17-92 | 13:00 | 4-17-92 | 13:30 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 15.5 | C1 | ____ – ____ |
| 15.5 – 35.5 | S1 | ____ – ____ |
| ____ – ____ | END CAP | ____ – ____ |
| ____ – ____ | | ____ – ____ |
| ____ – ____ | | ____ – ____ |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: #10/20 SILICA SAND FROM 30 FEET TO 8 FEET. SLUFF FROM 55 FEEET TO 30 FEET.

Grout Seal: REDI-MIX CEMENT FROM 6.5 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 8 FEET TO 6.5 FEET.

## Well Development:

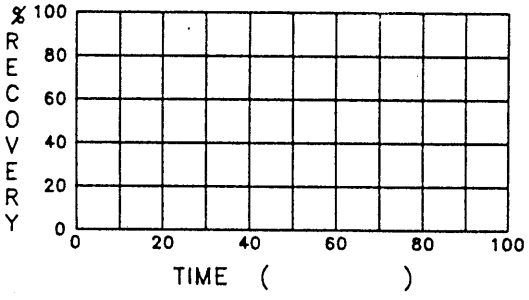
WELL DEVELOPED BY AIR LIFT METHODS ON 4-16-92 AND 4-17-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Recovery Data:

Q= $S_o$=

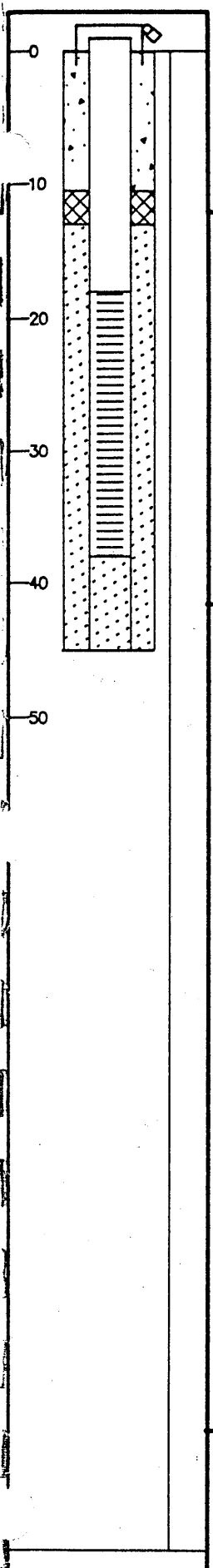



SUPERVISED BY DAVID GORDON

DATE 4-17-92

Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

Plate A18




Dames & Moore

Well No. DMX-3

Job No. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2070815 E298360

Elevation Ground Level 5082.5

Top of Casing 5083.9

## Drilling Summary:

Total Depth 45 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: +1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-14-92 | 13:15 | 4-14-92 | 14:00 |
| Geophys. Logging: | | | | |
| Casing: | 4-14-92 | 14:15 | 4-14-92 | 14:25 |
| Filter Placement: | 4-14-92 | 14:50 | 4-14-92 | 15:10 |
| Cementing: | 4-14-92 | 15:25 | 4-14-92 | 15:50 |
| Development: | 4-16-92 | 15:45 | 4-16-92 | 16:45 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 18 | C1 | ____ – ____ |
| 18 – 38 | S1 | ____ – ____ |
| ____ – ____ | END CAP | ____ – ____ |
| ____ – ____ | | ____ – ____ |
| ____ – ____ | | ____ – ____ |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: WASHED PEA GRAVEL FROM 45 FEET TO 13 FEET.

Grout Seal: REDI-MIX CEMENT FROM 10.5 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 13 FEET TO 10.5 FEET.

## Well Development:

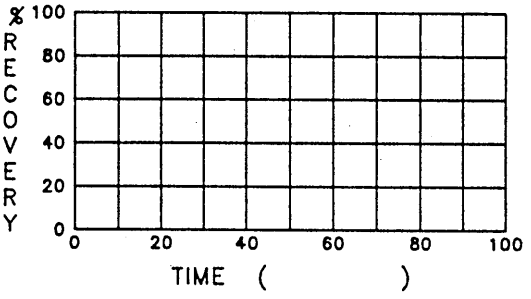
WELL DEVELOPED BY AIR LIFT METHODS ON 4-16-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## Recovery Data:

Q= $S_o$=




Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

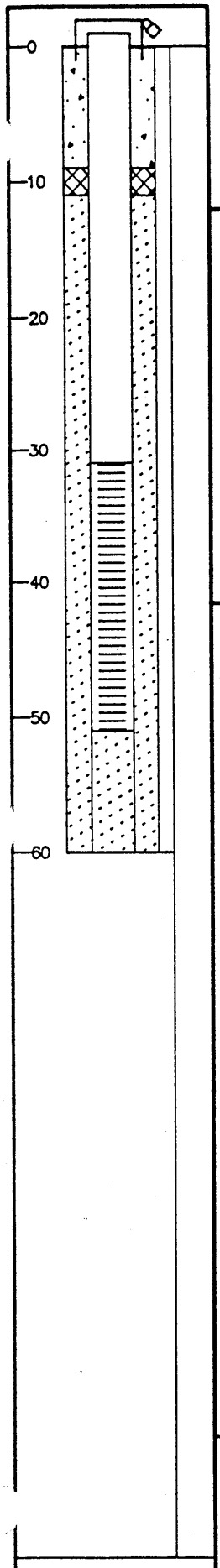
SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

SUPERVISED BY DAVID GORDON

DATE 4-17-92

**Plate A19**




Dames & Moore

Well No. DMX-4

Job NO. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2068350
E297860

Elevation Ground Level 5069.8

Top of Casing 5071.2

## Drilling Summary:

Total Depth 60 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: +1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-15-92 | 14:50 | 4-15-92 | 15:35 |
| Geophys. Logging: | | | | |
| Casing: | 4-15-92 | 15:50 | 4-15-92 | 16:15 |
| Filter Placement: | 4-15-92 | 16:20 | 4-15-92 | 16:40 |
| Cementing: | 4-16-92 | 08:30 | 4-16-92 | 09:00 |
| Development: | 4-16-92 | 16:45 | 4-16-92 | 17:45 |
| | 4-17-92 | 08:00 | 4-17-92 | 10:00 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 31 | C1 | ____ – ____ |
| 31 – 51 | S1 | ____ – ____ |
| ____ – ____ | END CAP | ____ – ____ |
| ____ – ____ | | ____ – ____ |
| ____ – ____ | | ____ – ____ |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: WASHED PEA GRAVEL FROM 30 FEET TO 11 FEET.

Grout Seal: REDI-MIX CEMENT FROM 9 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 11 FEET TO 9 FEET.

## Well Development:

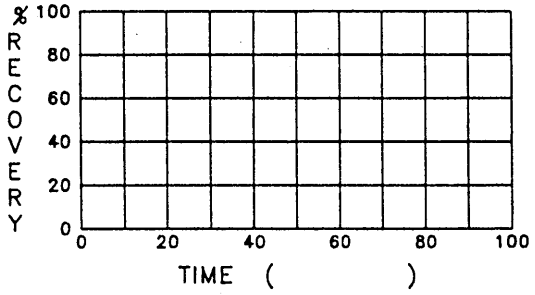
WELL DEVELOPED BY AIR LIFT METHODS ON 4-17-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Recovery Data:

Q= $S_o$=




Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

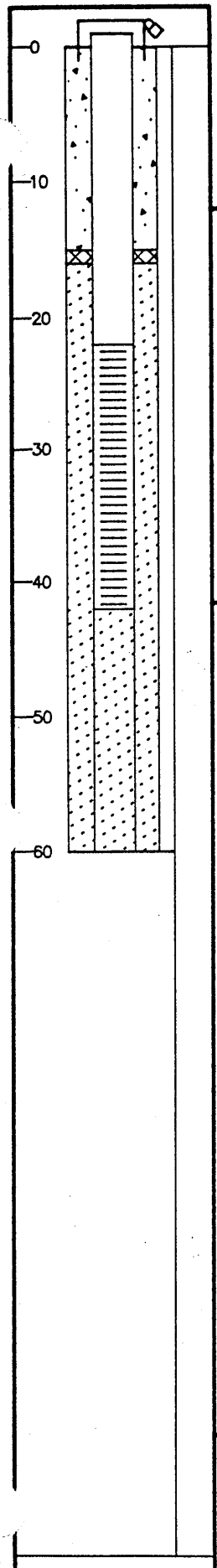
SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

SUPERVISED BY DAVID GORDON

DATE 4-17-92

Plate A20




Dames & Moore

Well No. DMX-5

Job NO. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2067620
E298645

Elevation Ground Level 5079.2

Top of Casing 5080.8

## Drilling Summary:

Total Depth 60 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: +1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-15-92 | 10:45 | 4-15-92 | 11:30 |
| Geophys. Logging: | | | | |
| Casing: | 4-15-92 | 11:45 | 4-15-92 | 12:00 |
| Filter Placement: | – | – | – | – |
| Cementing: | 4-15-92 | 12:50 | 4-15-92 | 14:00 |
| Development: | 4-17-92 | 10:00 | 4-17-92 | 11:00 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 22 | C1 | ____ – ____ |
| 22 – 42 | S1 | ____ – ____ |
| ____ – ____ | END CAP | ____ – ____ |
| ____ – ____ | | ____ – ____ |
| ____ – ____ | | ____ – ____ |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: NATURAL SLUFF FROM 60 FEET TO 16 FEET.

Grout Seal: REDI-MIX CEMENT FROM 15 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 16 FEET TO 15 FEET.

## Well Development:

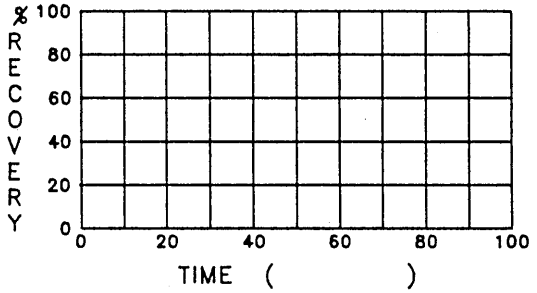
WELL DEVELOPED BY AIR LIFT METHODS ON 4-17-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## Recovery Data:

Q= $S_o$=




Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

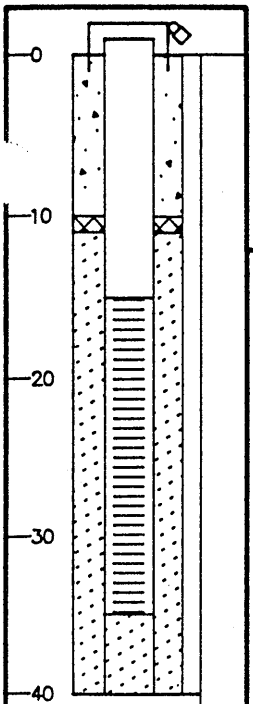
SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

SUPERVISED BY DAVID GORDON

DATE 4-17-92

**Plate A21**




Dames & Moore

Well No. DMX-6

Job No. 02353-118-022

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N2067120 E298710

Elevation Ground Level 5074.1

Top of Casing 5075.5

SITE NAME APS FOUR CORNERS S.E.S.

LOCATION CHACO WASH INTERCEPT

SUPERVISED BY DAVID GORDON

DATE 4-17-92

## Drilling Summary:

Total Depth 40 FEET
Borehole Diameter NOMINAL 8-INCH
Casing Stick-up Height: +1 FEET
Driller MO-TE DRILLING INC.
FARMINGTON, N.M.

Rig 1500 GARDNER-DENVER AIR ROTARY
Bit(s) 7 7/8-INCH BUTTON ROCK BIT

Drilling Fluid "QUICK FOAM"

Protective Casing 6-INCH STEEL WITH LOCKING CAP

## Construction Time Log:

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 4-16-92 | 09:45 | 4-16-92 | 10:15 |
| Geophys. Logging: | | | | |
| Casing: | 4-16-92 | 10:30 | 4-16-92 | 10:40 |
| Filter Placement: | 4-16-92 | 10:40 | 4-16-92 | 10:50 |
| Cementing: | 4-16-92 | 11:00 | 4-16-92 | 11:45 |
| Development: | 4-17-92 | 11:00 | 4-17-92 | 12:00 |

## Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

| Depth | String(s) | Elevation |
|---|---|---|
| +1 – 15 | C1 | ____ – ____ |
| 15 – 35 | S1 | ____ – ____ |
| ____ – ____ | END CAP | ____ – ____ |
| ____ – ____ | | ____ – ____ |
| ____ – ____ | | ____ – ____ |

Casing: C1 4-INCH, SCH 40 PVC, BLANK, FLUSH-THREADED.
C2 ____

Screen: S1 4-INCH, SCH 40 PVC, 0.020-INCH SLOT, FLUSH-THREADED.
S2 ____

Filter Pack: WASHED PEA GRAVEL FROM 40 FEET TO 11 FEET.

Grout Seal: REDI-MIX CEMENT FROM 10 FEET TO SURFACE.

Bentonite Seal: 1/4-INCH PELLETS FROM 11 FEET TO 10 FEET.

## Well Development:

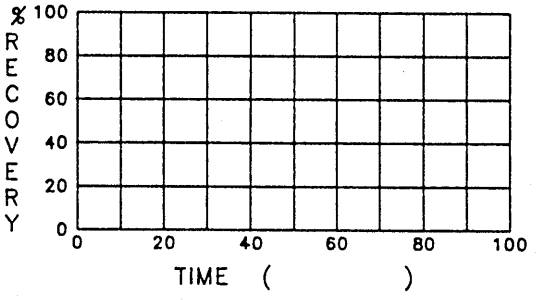
WELL DEVELOPED BY AIR LIFT METHODS ON 4-17-92.

## Stabilization Test Data:

| Time | pH | Spec. Cond. | Temp (C) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

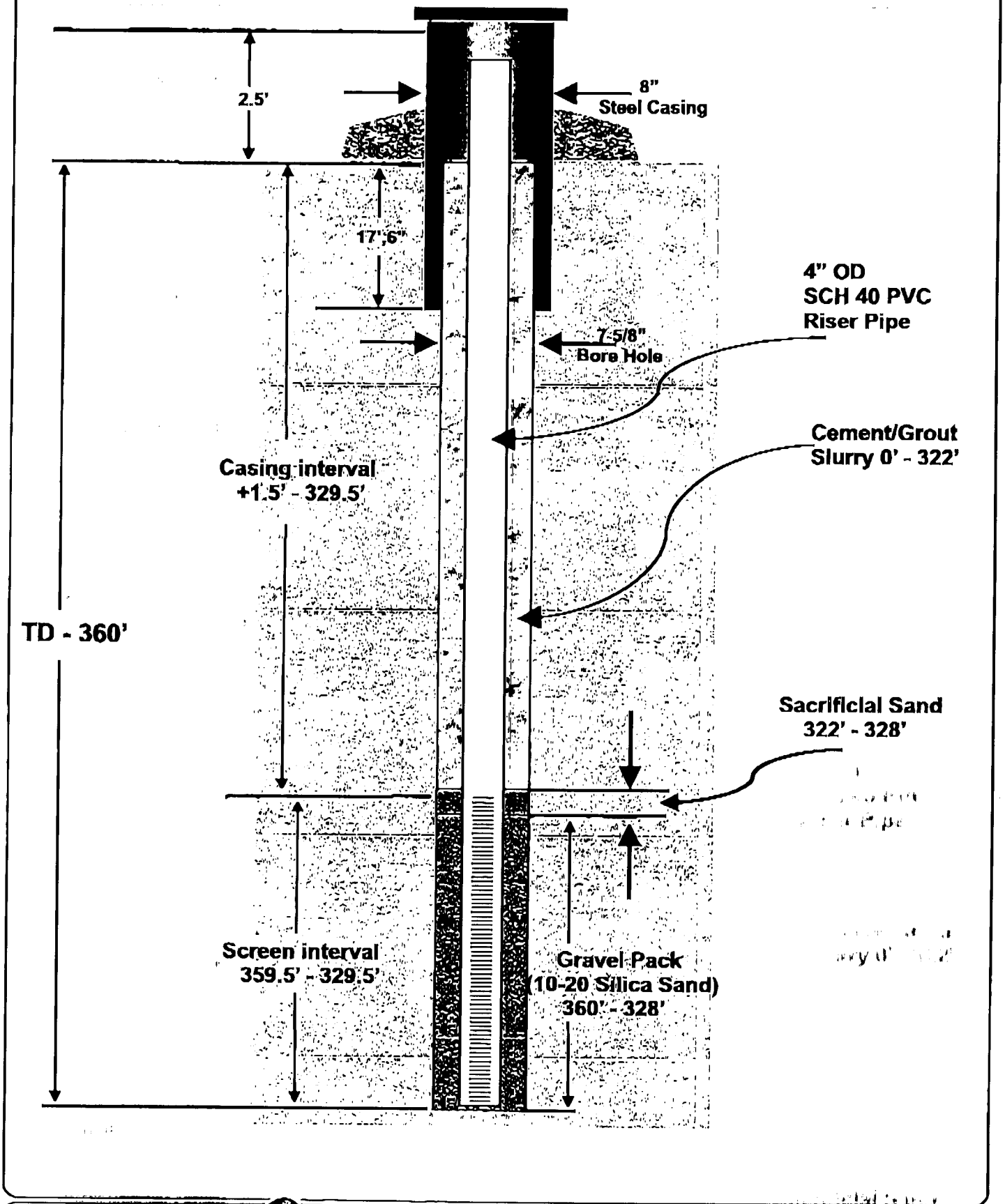
## Recovery Data:

Q= $S_o$=




Comments: SURVEY COORDINATES, ELEVATION GROUND LEVEL AND TOP OF CASING ARE ESTIMATED. SURVEY DATA TO BE PROVIDED LATER.

**Plate A22**

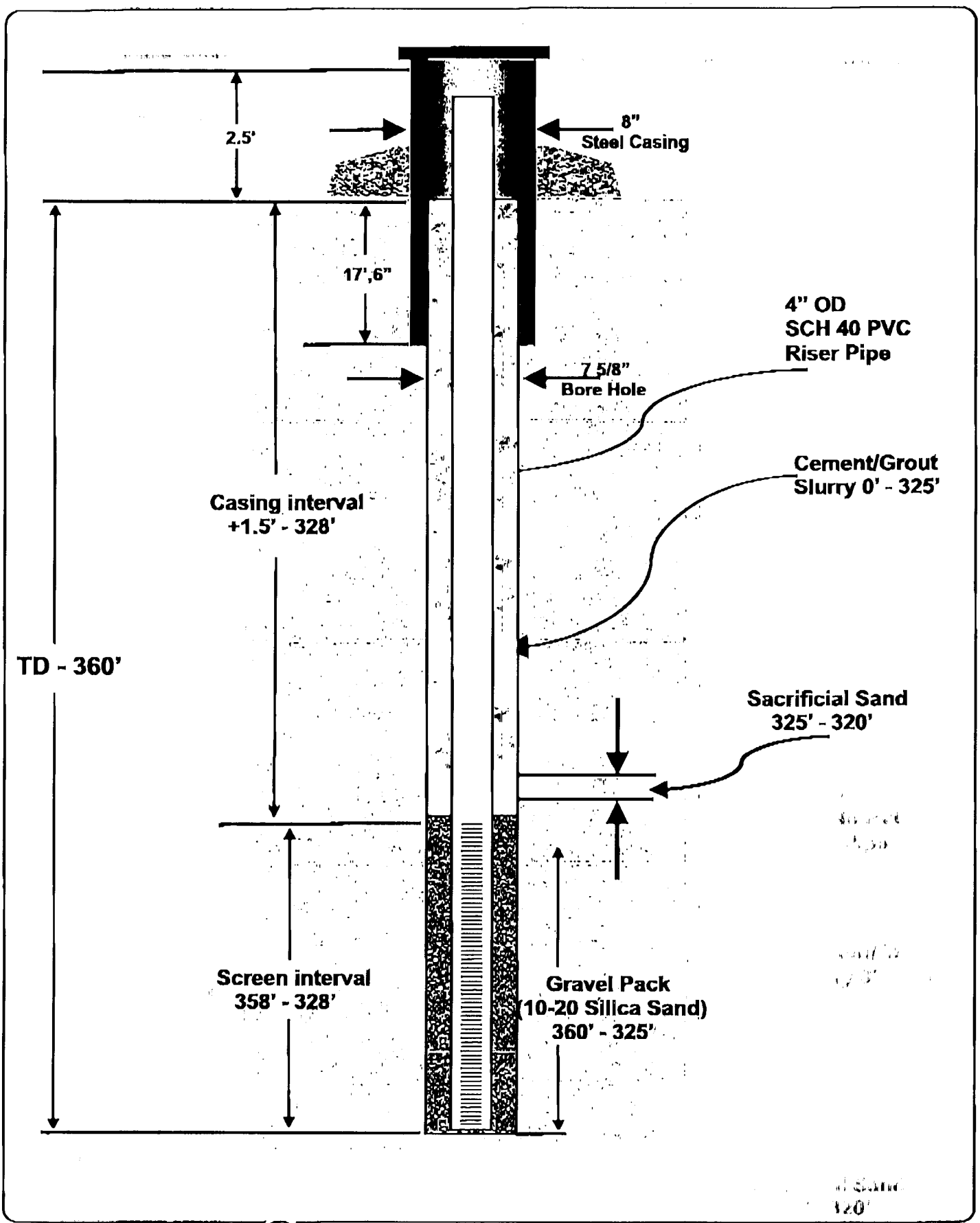



amec

Project Number 3-517-000131 October 2003

Four Corners Power Plant
Arizona Public Service Company
Monitor Well Installation
Fruitland, New Mexico

# Monitor Well Schematic LS-1




amec

Project Number 3-517-000131 October 2003

Four Corners Power Plant
Arizona Public Service Company
Monitor Well Instillation
Fruitland, New Mexico

# Monitor Well Schematic LS-2

| Project Name: APS Four Corners Power Plant | BOREHOLE LOG | amec |
|---|---|---|
| Project Number: 3-517000131 | | |
| Page: 1 of 1 | | |

BOREHOLE: LS-1 DIAMETER: 8" OD
LOCATION: N 36°41'08.3" W 108°29'39.3"
DRILL METHODS: Duel tube-RV-Circ
DRILL RIG TYPE: Schram T 660WS

LOGGED BY: Jim Criss
DRILLING DATE: 10 October 2003
DRILLER: Ellis Lorimor.
DRILL COMPANY: Rainbow Drilling, Inc.

DEPTH TO WATER: N/A
STABILIZATION TIME: N/A

REFERENCE POINT DESCRIPTION: GPS.
REFERENCE POINT ELEVATION: ~

| SAMPLE NO. | DEPTH, BGS (ft) | Blows/ft | | SAMPLE DESCRIPTION | STRATUM | NOTES |
|---|---|---|---|---|---|---|
| | 0-20 | | | Interbeded Sandstone and Clay - 1/8 inch Coal Seams. Sandstone is very fine with some calcarious cementation | | |
| | 20-40 | | | Same as above | | |
| | 40-60 | | | Lewis Shale formation: Shale with considerable silt, occasional fine sand. Predominately dark gray with occasional sight gray stringers. | | |
| | 60-80 | | | Same as above with less silt and no sand. | | |
| | 80-100 | | | Same as above | | |
| | 100-120 | | | Lewis Shale formation: Highley weathered, thick bedding, relatively soft, light gray to black. | | |
| | 120-140 | | | Same as above | | |
| | 140-160 | | | Same as above | | |
| | 160-180 | | | Same as above | | |
| | 180-200 | | | Same as above | | |
| | 200-220 | | | Same as above | | |
| | 220-240 | | | 1 to 2 foot layer of limestone. Very fractured, thinly beded, very hard, gray. 230'-232' | | |
| | 240-280 | | | Lewis Shale formation: somewhat carbonaceous, slightly to moderately weathered, very fractured, laminated, soft to moderately hard, brown to gray to black. | | |
| | 280-300 | | | Same as above | | |
| | 300-320 | | | Same as above | | |
| | 320-340 | | | Same as above | | |
| | 340-360 | | | Same as above. Total Depth 160' | | |

| Project Name: APS Four Corners Power Plant | BOREHOLE LOG | amec |
|---|---|---|
| Project Number: 3-517000131 | | |
| Page: 1 of 1 | | |

BOREHOLE: LS-2 DIAMETER: 8' OD
LOCATION: N 36°40'57.8" W 108°29'39".2"
DRILL METHODS: Duel tube-RV-Circ
DRILL RIG TYPE: Schram T 660WS

LOGGED BY: Jim Criss
DRILLING DATE: 10 October 2003
DRILLER: Ellis Lorimor.
DRILL COMPANY: Rainbow Drilling, Inc.

DEPTH TO WATER: N/A
STABILIZATION TIME: N/A

REFERENCE POINT DESCRIPTION: GPS.
REFERENCE POINT ELEVATION: ~

| SAMPLE NO. | DEPTH, BGS (ft) | Blows/ft | | SAMPLE DESCRIPTION | STRATUM | NOTES |
|---|---|---|---|---|---|---|
| | 0-20 | | | Pictured Cliffs Sandstone: Fine, very weathered, moderately hard, brown | | |
| | 20-40 | | | Same as above | | |
| | 40-60 | | | Lewis Shale formation: Shale with considerable silt, occasional fine sand. Predominately dark gray with occasional sight gray stringers. | | |
| | 60-80 | | | Same as above with less silt and no sand. Considerable gypsom in joints. Moderately to slightly weathered. | | |
| | 80-100 | | | Same as above | | |
| | 100-120 | | | Lewis Shale formation: Highley weathered, thick bedding, relatively soft, light gray to black. | | |
| | 120-140 | | | Same as above | | |
| | 140-160 | | | Same as above | | |
| | 160-180 | | | Same as above | | |
| | 180-200 | | | Same as above | | |
| | 200-220 | | | 1 to 2 foot layer of limestone. Very fractured, thinly beded, very hard, gray. 210'-212' | | |
| | 220-240 | | | Lewis Shale formation: somewhat carbonaceous, slightly to moderately weathered, very fractured, laminated, soft to moderately hard, brown to gray to black | | |
| | 240-280 | | | Same as above | | |
| | 280-300 | | | Same as above | | |
| | 300-320 | | | Same as above | | |
| | 320-340 | | | Same as above | | |
| | 340-360 | | | Same as above. Total Depth 160' | | |

**Job No.:** 23445882
**Client:** Arizona Public Service
**Project:** Phase I - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

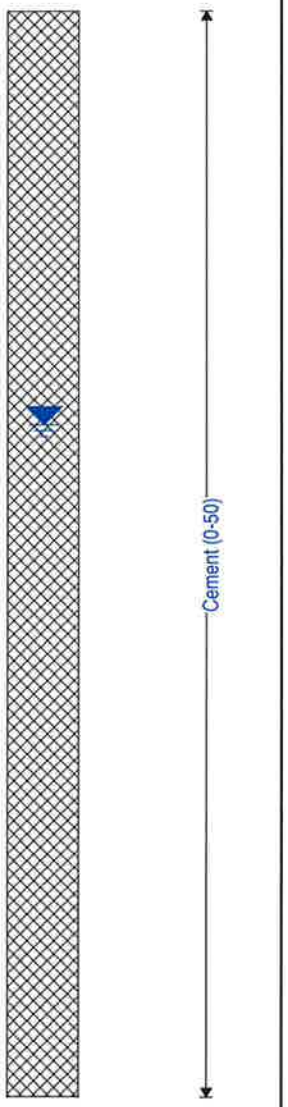
# Boring No. L1-1380

**Alternate ID:**

**Start Time:** 1100
**Start Date:** 6/8/10
**Finish Time:** 1305
**Finish Date:** 6/8/10

**Depth to Groundwater:** 19 ft bgs
**Date:** 6/8/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | NM | NM | NM | ***Lean Clay*** Light Brown, medium plasticity, dry, unweathered shale fragments present (0-2ft bgs) |
| | | Shale | | | | ***Weathered Shale*** Brown, weak to moderate cementation, iron staining and gypsum present, dry to moist |
| 5 | | | | | | |
| 10 | | | | | | |
| 15 | | | | | | Moist (15-19) |
| | | | | | | Wet clay, no gypsum (19-23) |
| 20 | | | | | | |
| | | | | | | Moist, iron staining and gypsum present (23-30) |
| 25 | | | | | | |
| 30 | | | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, dry, reacts with HCl |
| 35 | | | | | | |
| 40 | | | | | | |
| 45 | | | | | | |
| 50 | | | | | | Total Depth = 50ft |
| 55 | | | | | | |






URS
7720 North 16th St., Suite 100
Phoenix, Arizona 85020
(602) 371-1100

**Job No.:** 23445882
**Client:** Arizona Public Service
**Project:** Phase I - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

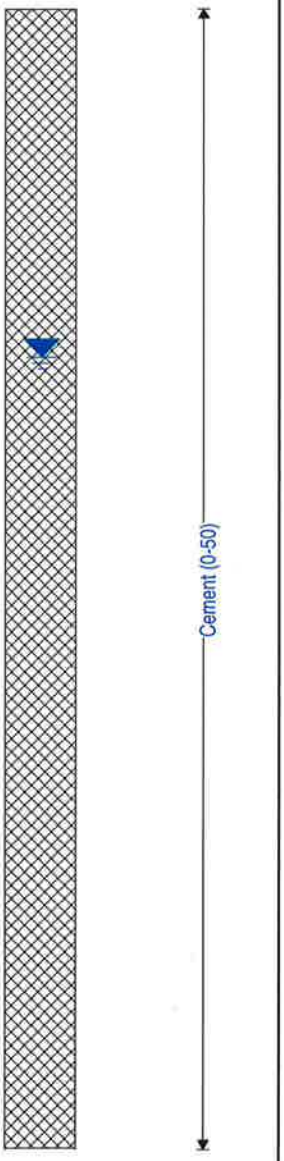
# Boring No. L1-1687

**Alternate ID:**

**Start Time:** 1540
**Start Date:** 6/6/10
**Finish Time:** 0900
**Finish Date:** 6/7/10

**Depth to Groundwater:** 15 ft bgs
**Date:** 6/6/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | NM | NM | NM | ***Lean Clay*** Brown, medium plasticity, very stiff, dry to moist |
| 5 | | | | | | |
| 10 | | | | | | Moist, soft to medium stiff at 12ft bgs |
| 15 | | | | | | Wet, soft to very soft (15-26ft bgs) |
| 20 | | | | | | |
| 25 | | | | | | Wet, stiff (26-27ft bgs) |
| 30 | | Shale | | | | ***Weathered Shale*** Brown, weak to moderate cementation, iron staining and trace gypsum, moist (28-45ft bgs) |
| 35 | | | | | | |
| 40 | | | | | | |
| 45 | | | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, reacts with HCl, dry to moist (45-52.5ft bgs) |
| 50 | | | | | | Total Depth = 52.5ft |
| 55 | | | | | | |



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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L1-2182

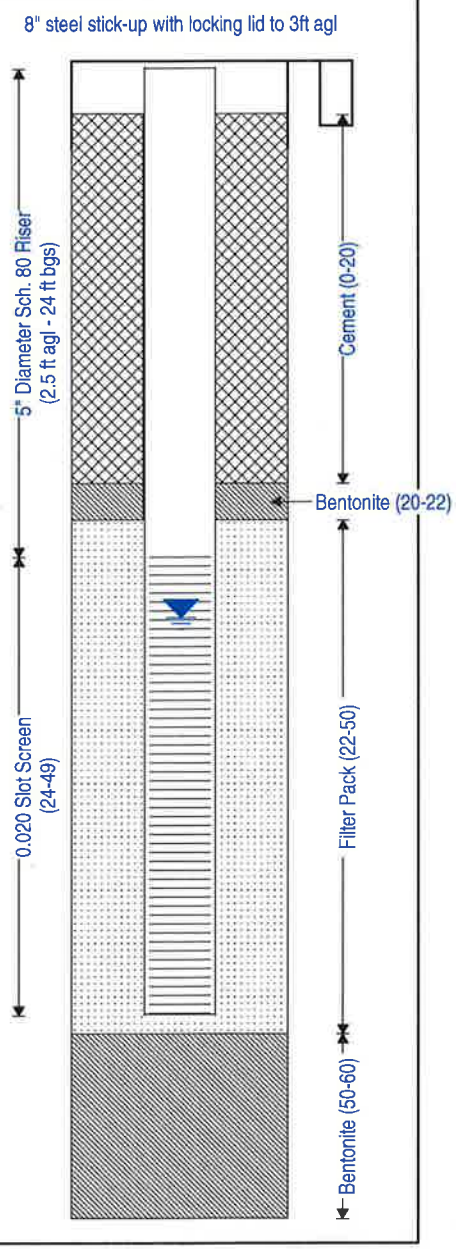
**Alternate ID:** MW-34

**Start Time:** 1530
**Start Date:** 6/8/10
**Finish Time:** 0815
**Finish Date:** 6/9/10

**Depth to Groundwater:** 27.30 ft bgs
**Date:** 6/9/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| -5 to 0 | | | | | | |
| 0 to 5 | | CL | 90 | 10 | 0 | ***Lean Clay*** Brown, medium plasticity, moist |
| 5 to 10 | | | 95 | 5 | 0 | Small clay balls (1/6in. to 1/2in. diameter) noted inside core (5-10ft bgs) |
| 10 to 15 | | | 95 | 5 | 0 | Same as above but dry (12-15ft bgs) |
| 15 to 20 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Light Brown, medium plasticity, dry, soft (15-33ft bgs) |
| 20 to 25 | | | 70 | 30 | 0 | Moist (21-22ft bgs) Wet (22-33ft bgs) Medium plasticity, soft |
| 25 to 30 | | | | | | |
| 30 to 35 | | | | | | |
| 35 to 40 | | SP-SC | 7 | 93 | T | ***Poorly Graded Sand with Clay*** Brown, fine to medium grained, wet (33-50ft bgs) |
| 40 to 45 | | | | | | |
| 45 to 50 | | | | | | |
| 50 to 55 | | Shale | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, moist (50-60ft bgs) |
| 55 to 60 | | | | | | Total Depth = 60ft |

As-Built



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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

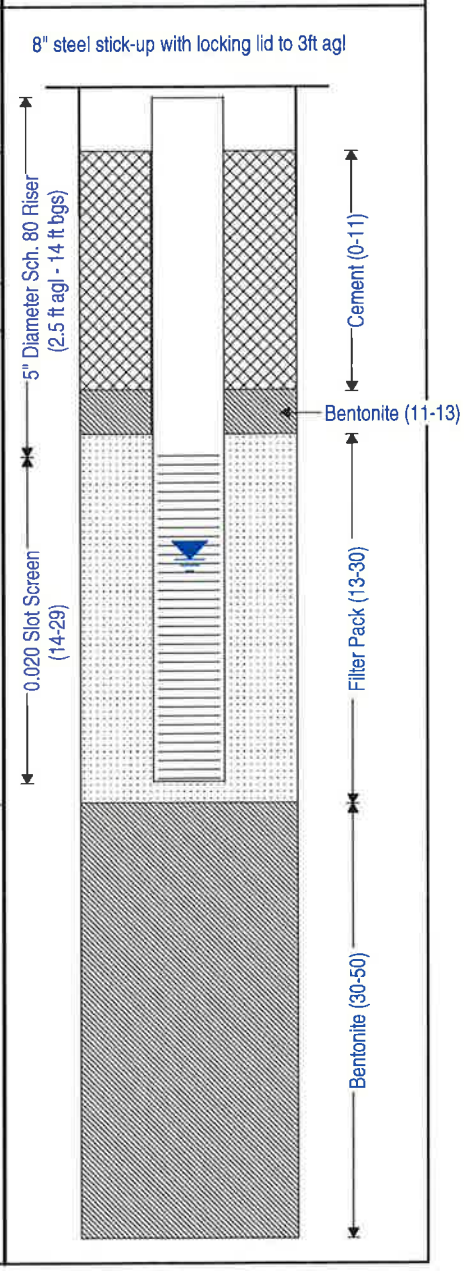
# Boring No. L1-3090

**Alternate ID:** MW-33

**Start Time:** 1325
**Start Date:** 6/7/10
**Finish Time:** 1610
**Finish Date:** 6/7/10

**Depth to Groundwater:** 18.74 ft bgs
**Date:** 6/9/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 93 | 5 | 2 | ***Lean Clay*** Light brown, medium plasticity, very soft, loose, dry (0-6ft bgs) |
| 5 | | CL | 75 | 5 | 20 | ***Gravelly Lean Clay*** Light brown, gravel is subrounded to rounded, clay has medium plasticity, very soft, loose (6-8ft bgs) |
| 10 | | Shale | | | | ***Weathered Shale*** Brown, weak to moderate cementation, dry to moist, gypsum and iron staining present<br>Moist (15-17ft bgs)<br>Wet, clay present, no gypsum (18-21ft bgs)<br>Moist (21-22ft bgs)<br>Wet (22-25ft bgs), clay present, no gypsum<br>Moist (25-30ft bgs) |
| 30 | | | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, dry to moist, reacts with HCl (30-50ft bgs) |
| 50 | | | | | | Total Depth = 50ft |





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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

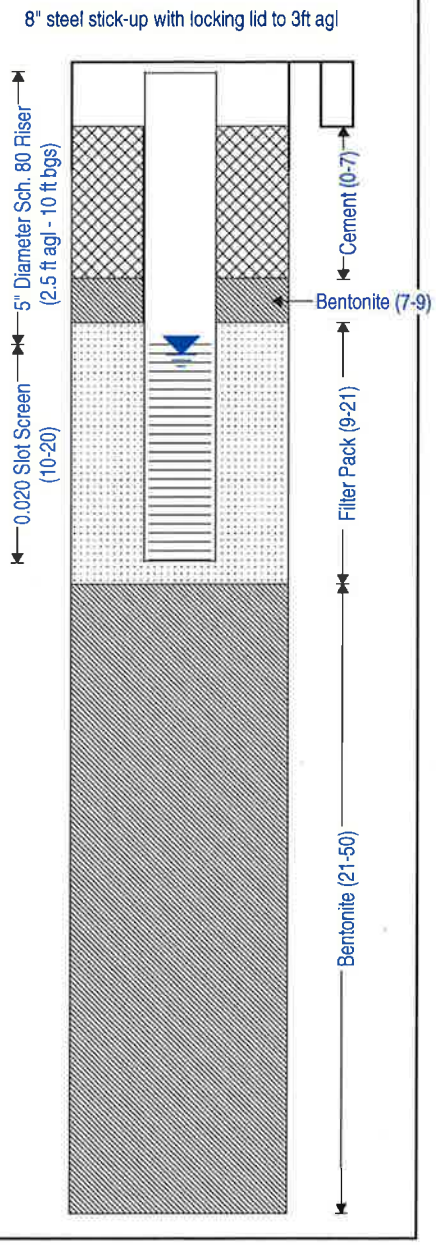
# Boring No. L3-949

**Alternate ID:** MW-32

**Start Time:** 0900
**Start Date:** 6/6/10
**Finish Time:** 1215
**Finish Date:** 6/6/10

**Depth to Groundwater:** 10.45 ft bgs
**Date:** 6/6/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 90 | 10 | T | ***Lean Clay*** Brown, medium plasticity, moist (0-4.5ft bgs) |
| 5 | | Shale | | | | ***Poorly Graded Sand*** Fine to medium grained, moist, (4.5-5ft bgs) F%=5, S%=95, G%=0 |
| 10 | | | | | | ***Weathered Shale*** Brown, weak to moderate cementation, iron staining and gypsum present, moist (5-10ft bgs) |
| | | | | | | Wet, mostly clay with iron staining (10-13ft bgs) |
| | | | | | | 1/16in. thick layer of gypsum, moist (13-14ft bgs) |
| 15 | | | | | | Wet, mostly clay with iron staining (14-17ft bgs) |
| 20 | | | | | | Same as above but moist (17-21ft bgs) 1in. thick layer of wet shale at 18.8' bgs |
| 25 | | | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, moist to dry, calcite present in small amounts, reacts with HCl (21-50ft bgs) |
| 30 | | | | | | |
| 35 | | | | | | |
| 40 | | | | | | |
| 45 | | | | | | |
| 50 | | | | | | TD= 50ft bgs |



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**Job No.:** 23445882
**Client:** Arizona Public Service
**Project:** Phase I - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

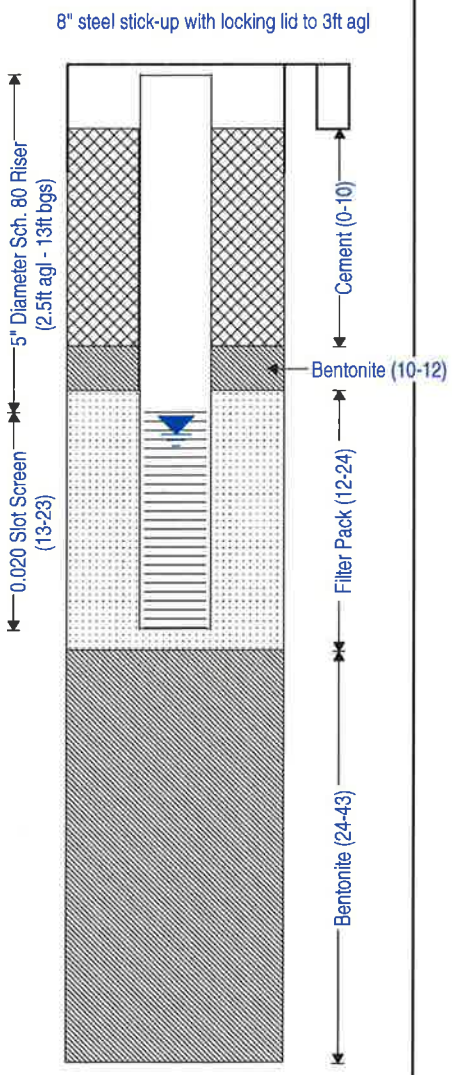
# Boring No. L3-1532

**Alternate ID:** MW-30

**Start Time:** 1325
**Start Date:** 6/2/10
**Finish Time:** 1800
**Finish Date:** 6/2/10

**Depth to Groundwater:** 14 ft bgs
**Date:** 6/2/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 95 | 5 | 0 | ***Lean Clay*** Brown, medium plasticity, medium stiff, moist (0-3.5ft bgs) |
| 5 | | Shale | | | | ***Clayey Sand with Gravel*** Brown, mostly coarse sand, fine to coarse gravel, sub-rounded to sub-angular, moist (3.5-4 ft bgs) F%=30, S%=50, G%=20 |
| | | | | | | ***Weathered Shale*** Brown with red and white staining, weakly cemented, iron staining, very little gypsum crystals (4-6ft bgs) |
| 10 | | | | | | Brown, weak to moderate cementation, iron staining, little but increasing amount of gypsum crystals (6-15ft bgs) |
| 15 | | | | | | Brown, high clay content, wet and visible water in clay layers, no iron staining or gypsum visible (15-16ft bgs) |
| 20 | | | | | | Brown with moderate cementation, some iron staining and gypsum present, black and brown laminations present (16-24ft bgs) |
| 25 | | | | | | ***Unweathered Shale*** Blue-Gray, contains very fine grained sand, black and blue-gray layers, moderate to strong cementation, dry, reacts with Hydrochloric Acid (24-43ft bgs) |
| 30 | | | | | | |
| 35 | | | | | | |
| 40 | | | | | | Total Depth = 43 ft |
| 45 | | | | | | |
| 50 | | | | | | |



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**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

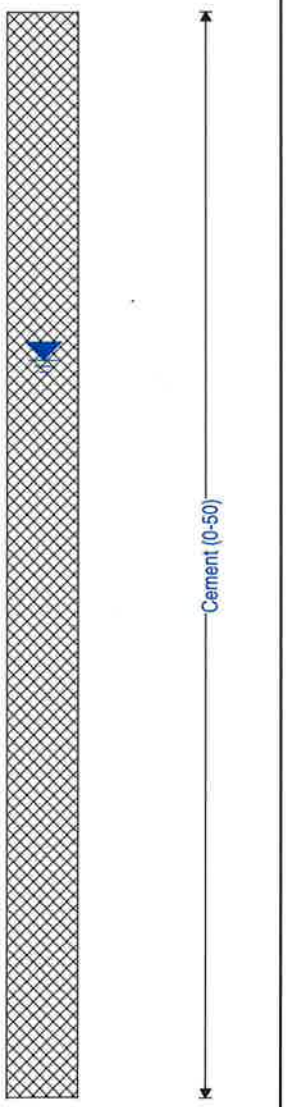
# Boring No. L3-1747

**Alternate ID:**

**Start Time:** 1337
**Start Date:** 6/5/10
**Finish Time:** 1656
**Finish Date:** 6/5/10

**Depth to Groundwater:** 16 ft bgs
**Date:** 6/5/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | T | ***Sandy Lean Clay***<br>Light Brown, medium plasticity, dry to moist, trace amounts of gypsum (0-6ft bgs) |
| 5 | | Shale | | | | ***Weathered Shale***<br>Brown, weak to moderate cementation, iron staining and gypsum present, moist<br><br>1in. thick layer at 16ft bgs wet with visible water, otherwise moist<br><br>1/2in. thick layer at 19ft bgs wet with visible water, otherwise moist |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | ***Unweathered Shale***<br>Blue-Gray, moderate to strong cementation, dry, gypsum noted (20-20.5ft bgs)<br><br>Reacts with HCl at 28ft bgs<br><br>Moist (30-31ft bgs)<br>Dry (31-32ft bgs)<br>1in. thick layer of wet unweathered shale noted at 32ft bgs, otherwise dry<br><br>Total Depth = 50ft |
| 25 | | | | | | |
| 30 | | | | | | |
| 35 | | | | | | |
| 40 | | | | | | |
| 45 | | | | | | |
| 50 | | | | | | |
| 55 | | | | | | |



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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (GP24-300RS)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L3-1957

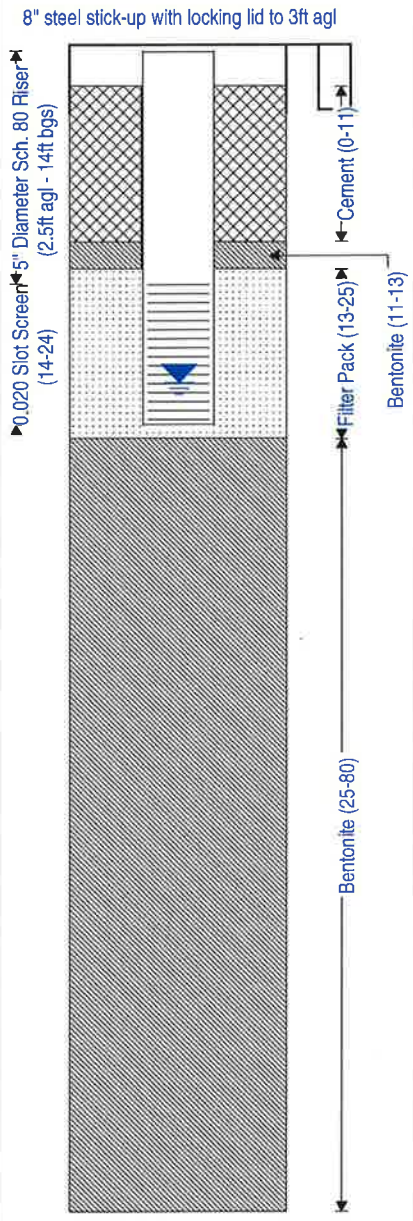
**Alternate ID:** MW-31

**Start Time:** 1535
**Start Date:** 6/3/10
**Finish Time:** 1735
**Finish Date:** 6/4/10

**Depth to Groundwater:** 21 ft bgs
**Date:** 6/4/10

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | SM | 40 | 60 | T | ***Silty Sand*** Light Brown, mostly fine grained, weakly cemented, moist |
| 10 | | Shale | | | | ***Weathered Shale*** Brown, weathered, weak to moderate cementation, iron staining, gypsum present, moist (10-15ft bgs) |
| 15 | | | | | | Weak cementation, trace gypsum, abundant clay content, moist to wet (15-16ft bgs) |
| 20 | | | | | | Vertical cracks in clay, wet (16-17ft bgs) |
| 25 | | | | | | Weak to moderate cementation, increased iron staining and gypsum content, horizontal sheets of weathered shale 1/8in. to 1/2in. thick (17-25ft bgs) |
| 30 | | | | | | Vertical crack noted in core 1/2in. thick at 22.5ft bgs |
| 35 | | | | | | ***Unweathered Shale*** Blue-Gray, moderate to strong cementation, shale broken into 1/8in. to 1/2in. thick flat fragments, reacts with HCl, moist |
| 40 | | | | | | Moist to wet 1in. thick layer of unweathered shale containing clay at 44ft bgs |
| 45 | | | | | | Moist to wet 1in. thick layer of unweathered shale with abundant clay at 47ft bgs |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | 1in. thick layer of moist to wet unweathered shale with abundant clay content at 65ft bgs |
| 65 | | | | | | |
| 70 | | | | | | |
| 75 | | | | | | Total Depth = 80 ft |
| 80 | | | | | | |

As-Built



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L3-510

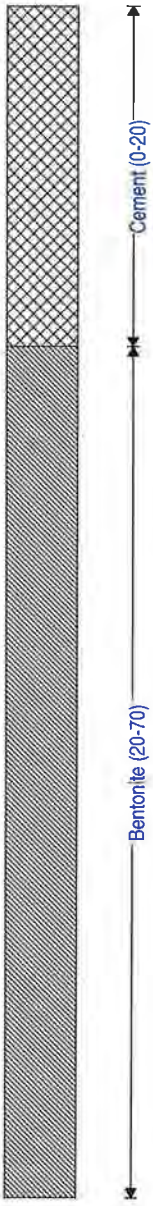
**Alternate ID:** None

**Start Time:** 1250
**Start Date:** 9/8/10
**Finish Time:** 0945
**Finish Date:** 9/9/10

**Depth to Groundwater:** Not measured
**Surface Elevation:** 5089.88

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 85 | 15 | 0 | ***Lean Clay with Sand***<br>Light Brown, medium plasticity, medium toughness, moist (0-13ft) |
| 15 | | Shale | | | | ***Weathered Shale with Lean Clay***<br>Brown, trace gypsum, moist<br>Highly fractured, moist (17-18ft)<br>Dark brown lean clay, moist to wet (18-19ft)<br>Dark brown weathered shale, highly fractured, wet, trace gypsum (19-39ft) |
| 40 | | | | | | ***Unweathered Shale***<br>Blue-Gray, moderate to strong cementation, moist to dry<br>Mostly dry (45ft)<br>Dry (60ft)<br>Total Depth = 70ft |

As-Built



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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

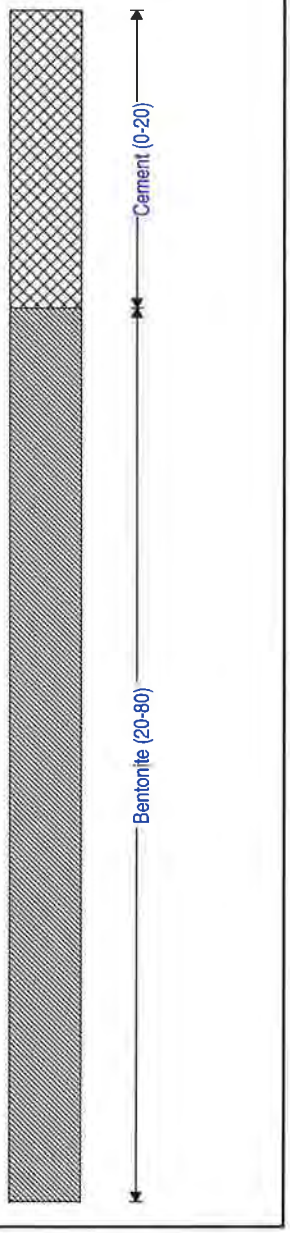
# Boring No. L3-2200

**Alternate ID:** None

**Start Time:** 0935
**Start Date:** 9/10/10
**Finish Time:** 1505
**Finish Date:** 9/10/10

**Depth to Groundwater:** Not measured
**Surface Elevation:** 5089.88

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 80 | 20 | 0 | ***Lean Clay with Sand***<br>Brown, medium plasticity, medium toughness, dry (0-3ft) |
| 5 | | SC | 25 | 75 | T | ***Clayey Sand***<br>Brown, fine to medium grained sand, very loose (3-14ft) |
| 10 | | | | | | |
| 15 | | SP | 2 | 98 | T | ***Sand***<br>Light Brown, fine to medium, (14-17ft) |
| 20 | | Shale | | | | ***Weathered Shale***<br>Brown, iron staining, gypsum, moist (17-33ft)<br>Fractured and wet (20-21ft and 22-23ft) |
| 25 | | | | | | |
| 30 | | | | | | |
| 35 | | | | | | ***Unweathered Shale***<br>Blue-Gray, moist, fractured (33-34ft) |
| 40 | | | | | | Dry competent rock (34-80ft) |
| 45 | | | | | | |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | |
| 65 | | | | | | |
| 70 | | | | | | Total Depth = 80ft |
| 75 | | | | | | |
| 80 | | | | | | |



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**Driller:** Boart Longyear
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**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L3-1350

**Alternate ID:** None

**Start Time:** 1248
**Start Date:** 9/9/10
**Finish Time:** 1545
**Finish Date:** 9/9/10

**Depth to Groundwater:** Not measured
**Surface Elevation:** 5096.80

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % |
|---|---|---|---|---|---|
| 0 | | | | | |
| 5 | | Shale | | | |
| 10 | | SP | 2 | 55 | 43 |
| 15 | | Shale | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | |
| 50 | | | | | |
| 55 | | | | | |
| 60 | | | | | |

**Lean Clay**
Light Brown, medium plasticity, medium toughness, moist (0-1ft)
Fines%(90) Sand%(10)

**Sand with Gravel**
Brown, poorly graded, fine to medium grained sand, fine well rounded gravel, moist (1-2ft)
Sand% (80) Gravel% (20) Fines%(T)

**Clayey Gravel with Sand**
Dark Brown, mostly fine well rounded gravel, wet (2-2.5ft)
Fines%(30) Sand%(20) Gravel%(50)

**Weathered Shale with Lean Clay**
Highly fractured, iron staining, moist (2.5-7ft)

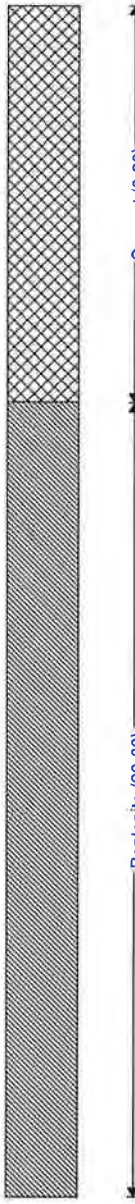
**Sand with Gravel**
Brown, poorly graded, fine to medium sand, gravel fine, well rounded (7-10ft)

**Weathered Shale**
Brown, highly fractured, clay present, some gypsum, iron staining, moist
Wet (14-16ft)
Moist (16-24ft) 1/4 inch gypsum layer noted at 24ft, wet

**Unweathered Shale**
Blue-Gray
Highly fractured, moist to dry (24-25ft)

Dry competent rock (25-60ft)

Total Depth = 60ft



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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

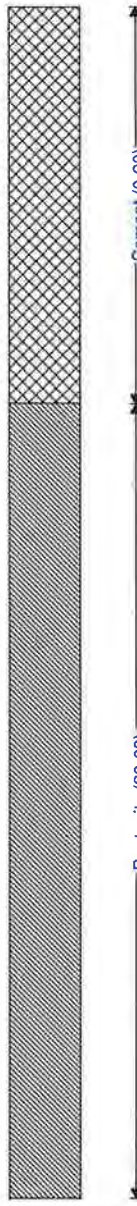
# Boring No. L2-Minus390

**Alternate ID:** None

**Start Time:** 0836
**Start Date:** 9/11/10
**Finish Time:** 1400
**Finish Date:** 9/11/10

**Depth to Groundwater:** Not measured
**Surface Elevation:** 5095.85

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Brown, fine to medium grained sand, clay has medium plasticity, medium toughness, moist (0-7ft) Dry (0-2ft) Moist (2-7ft) |
| 5 | | | | | | |
| | | SP/SC | 10 | 88 | 2 | ***Sand with Clay*** Brown, poorly graded, fine to medium grained, loose, moist (7-9ft) |
| 10 | | SP/SW | | | | ***Sand with Gravel*** Brown, poorly graded, fine to medium, gravel mostly fine, well rounded, dry to moist (9-10ft) Fines% (T) Sand% (80) Gravel% (20) Well Graded (10-11ft) Fines% (T) Sand% (70) Gravel% (30) |
| | | Shale | | | | ***Weathered Shale*** Brown, iron staining, fractured, moist (11-28ft) |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | Visible water in fractures (28-31ft) |
| 30 | | | | | | Moist (31-31ft) |
| 35 | | | | | | Visible water in fractures (33-36ft) |
| | | | | | | ***Unweathered Shale*** Blue-Gray Dry to moist (36-42ft) |
| 40 | | | | | | |
| 45 | | | | | | Dry (42-60ft) |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | Total Depth = 60ft |

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**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L2-3397

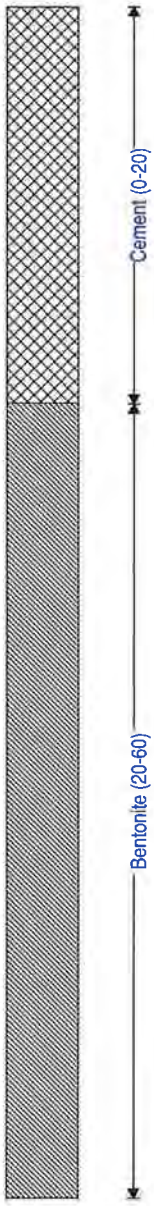
**Alternate ID:** None

**Start Time:** 1005
**Start Date:** 9/13/10
**Finish Time:** 1530
**Finish Date:** 9/13/10

**Depth to Groundwater:** Not measured
**Surface Elevation:** 5088.00

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Lean Clay with Sand***<br>Brown, medium plasticity, medium toughness, moist (0-16ft) |
| 15 | | Shale | | | | ***Clayey Sand***<br>Brown, fine to medium grained sand, wet (16-17ft)<br>***Weathered Shale***<br>Brown, iron staining, clay present, moist (17-27ft)<br>Moist, fracture zones wet (27-34ft)<br>Gypsum present (30-34ft)<br>Moist (34-36ft) |
| 35 | | | | | | ***Unweathered Shale***<br>Blue-Gray, dry (36-60ft)<br>Total Depth = 60ft |
| 60 | | | | | | |

As-Built



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(602) 371-1100

**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

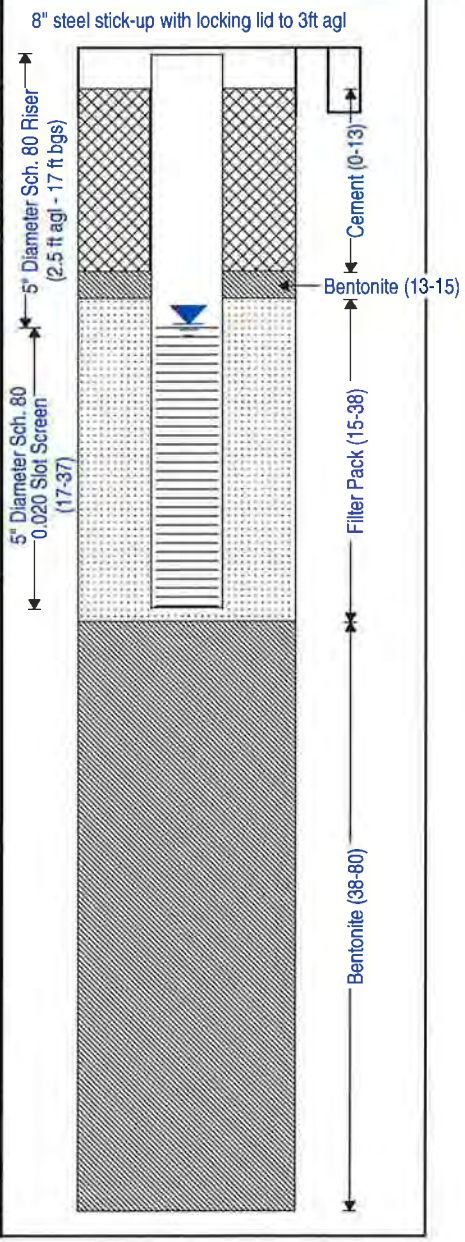
# Boring No. L2-3077

**Alternate ID:** MW-36

**Start Time:** 0910
**Start Date:** 9/14/10
**Finish Time:** 1645
**Finish Date:** 9/14/10

**Depth to Groundwater:** 16.71 ft bgs 9/15/10
**Surface Elevation:** 5086.840

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Brown, fine to medium sand, clay has medium plasticity, medium toughness, moist (0-4ft) |
| 5 | | SP | 2 | 95 | 3 | ***Sand*** Brown, poorly graded, mostly fine grained, moist (4-6ft) |
| | | Shale | | | | ***Weathered Shale*** Brown, broken into small angular fragments, moist (6-8ft) |
| 10 | | Shale | | | | ***Sand with Gravel*** Brown, well graded, fine to coarse sand, fine gravel, rounded, moist (8-9ft) Fines% (T) Sand% (80) Gravel% (20) |
| | | | | | | ***Weathered Shale*** Brown, highly fractured, moist (9-15ft) |
| | | | | | | Fracture zones noted to contain clay and are wet (15-35ft) |
| 35 | | | | | | ***Unweathered Shale*** Blue-Gray, dry Fractures are moist (35-37ft) Fractures are wet (37-38ft) |
| | | | | | | Dry (38-80ft) |
| 80 | | | | | | Total Depth = 80ft |



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

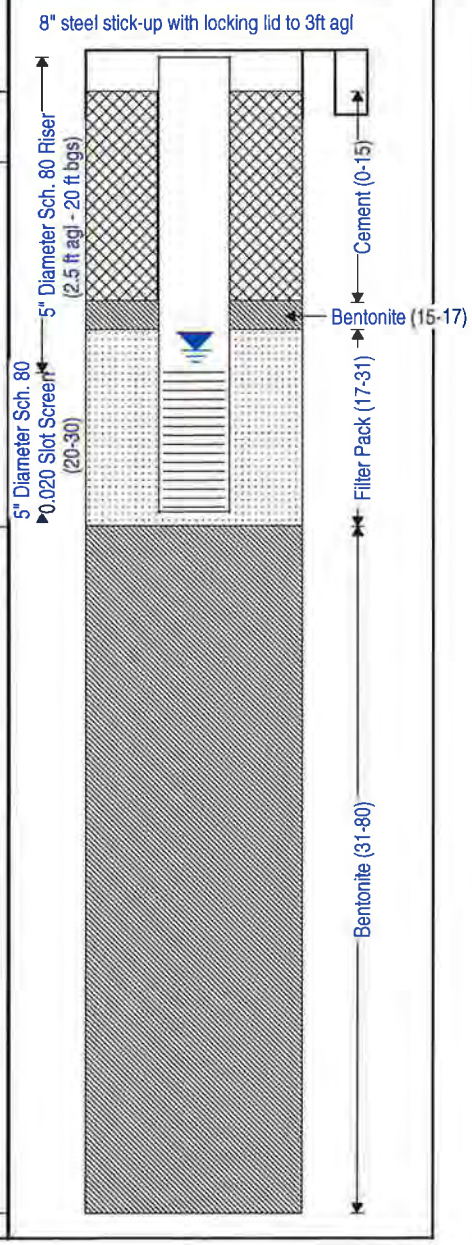
# Boring No. L2-280

**Alternate ID:** MW-35

**Start Time:** 1525
**Start Date:** 9/11/10
**Finish Time:** 1315
**Finish Date:** 9/12/10

**Depth to Groundwater:** 18.43 ft bgs 9/12/10
**Surface Elevation:** 5088.208

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 65 | 35 | T | ***Sandy Lean Clay***<br>Brown, medium plasticity, medium toughness, moist |
| 5 | | Shale | | | | ***Weathered Shale***<br>Brown, fractured, iron staining<br><br>Moist (5-18ft)<br><br>Wet (18-31ft) |
| 30 | | | | | | ***Unweathered Shale***<br>Blue-Gray<br>Moist to dry (31-32ft bgs)<br>Dry (32-42ft)<br><br>Wet (42-43ft)<br><br>Dry with moist layers in fractures (43-80ft) |
| 80 | | | | | | Total Depth = 80ft |



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

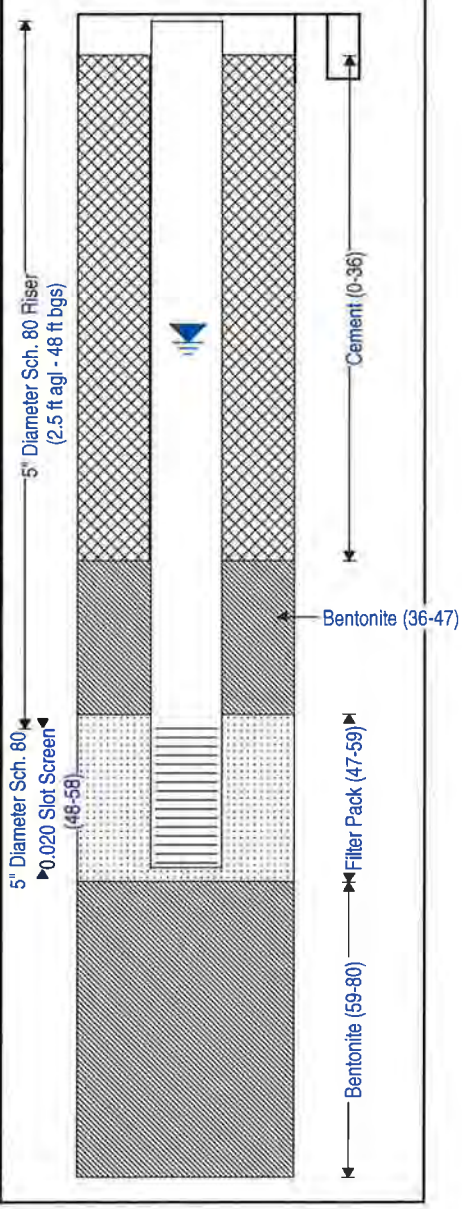
# Boring No. L2-1368

**Alternate ID:** MW-37

**Start Time:** 0840
**Start Date:** 9/22/10
**Finish Time:** 1200
**Finish Date:** 9/23/10

**Depth to Groundwater:** 20.41 ft bgs 9/25/10
**Surface Elevation:** 5089.864

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Brown, medium plasticity, medium toughness, moist (0-8ft) |
| 10 | | Shale | | | | ***Weathered Shale*** Brown, with clay, fractures moist (8-18ft) |
| | | | | | | Wet, lean clay with shale fragments (18-20ft) |
| | | | | | | Fractured, wet in fractures (20-36ft) |
| 40 | | | | | | ***Unweathered Shale*** Blue-Gray, dry (36-48ft) |
| | | | | | | Fractures are wet (48-58ft) Rock dry between fractures, fractures range from 0.25 - 5in apart with dry competent rock between (52-58ft) |
| | | | | | | Dry, hard, competent (58-60ft) |
| | | | | | | Fractured with clay, wet (60-61ft) |
| | | | | | | Dry, hard, competent (61-71ft) |
| | | | | | | Several fracture zones noted 1-3in thick in dry, competent rock (71-80ft) |
| 80 | | | | | | Total Depth = 80ft |



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L2-1358

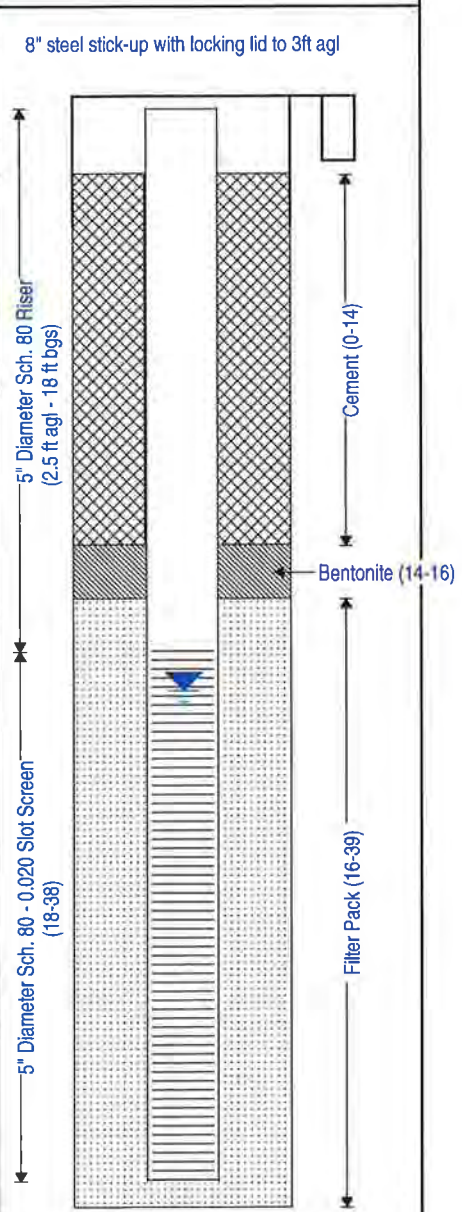
**Alternate ID:** MW-39

**Start Time:** 1140
**Start Date:** 9/26/10
**Finish Time:** 1400
**Finish Date:** 9/26/10

**Depth to Groundwater:** 19.45 ft bgs 9/29/10
**Surface Elevation:** 5089.967

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay***<br>Brown, medium plasticity, medium toughness, moist (0-8ft) |
| 10 | | Shale | | | | ***Weathered Shale***<br>Brown, moist (8-18ft)<br>Fractured, contains clay, wet (18-39)<br>Blue-Gray Unweathered Shale, dry (39ft)<br>Total Depth = 39ft |

As-Built



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

# Boring No. L2-1158

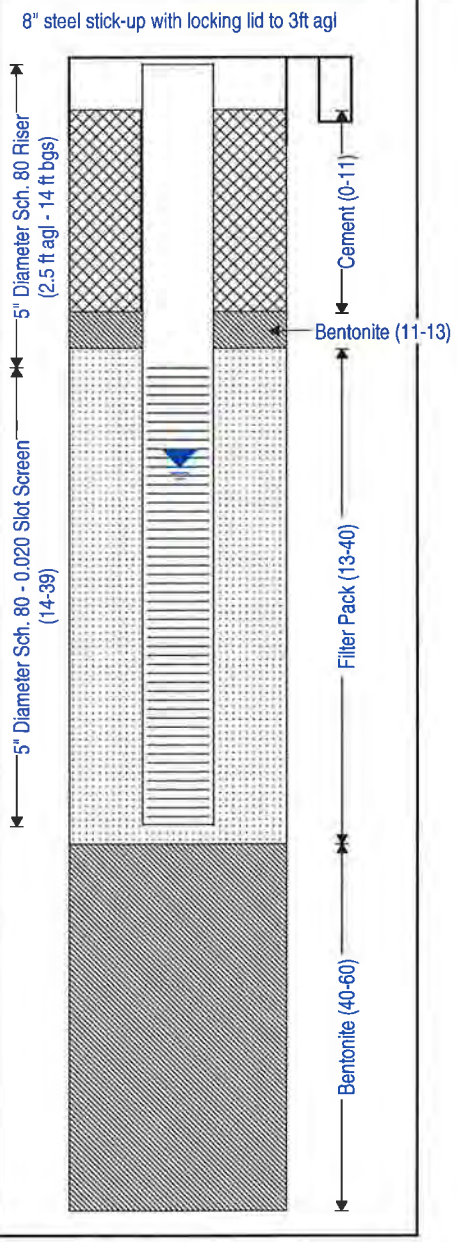
**Alternate ID:** MW-38

**Start Time:** 0930
**Start Date:** 9/24/10
**Finish Time:** 1355
**Finish Date:** 9/24/10

**Depth to Groundwater:** 19.41 ft bgs 9/25/10
**Surface Elevation:** 5089.685

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| -5 to 0 | | | | | | |
| 0 to 5 | | CL | 90 | 10 | 0 | ***Lean Clay*** Brown, medium plasticity, medium toughness, wet (0-4ft) Moist (4-8ft) |
| 5 to 10 | | CL | 65 | 35 | 0 | ***Sandy Lean Clay*** Brown, medium plasticity, medium toughness, moist (8-14ft) |
| 10 to 15 | | CL | 90 | 10 | 0 | ***Lean Clay*** Medium plasticity, medium toughness, wet (14-28ft) 2 in thick layer of clayey sand, fine to coarse, wet (27ft) |
| 15 to 20 | | | | | | |
| 20 to 25 | | | | | | |
| 25 to 30 | | | | | | |
| 30 to 35 | | SC | 35 | 50 | 15 | ***Clayey Sand with Gravel*** Fine to coarse sand, fine to coarse angular gravel, wet (28-36ft) |
| 35 to 40 | | CL | 85 | 15 | T | ***Lean Clay with Sand*** Brown, moist (36-38ft) |
| 40 to 45 | | Shale | | | | ***Weathered Shale*** Brown, moist (38-44ft) |
| 45 to 50 | | | | | | ***Unweathered Shale*** Blue-Gray, fractures are wet (44-46ft) Wet Blue-Gray clay containing unweathered shale fragments (46-46.5ft) Dry, hard, competent (47-60ft) Fossils observed (50ft) |
| 50 to 55 | | | | | | |
| 55 to 60 | | | | | | Total Depth = 60ft |

As-Built



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

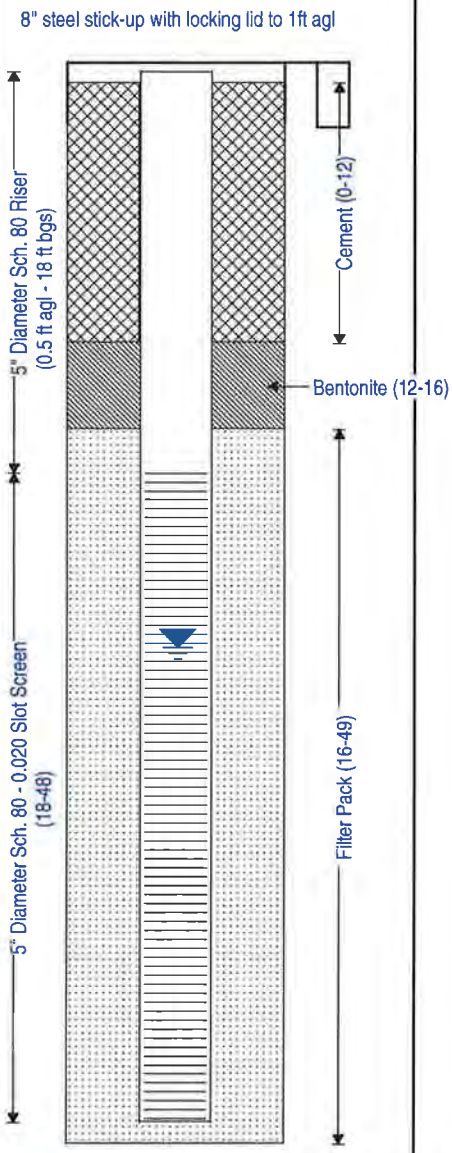
# Boring No. EW-14

**Alternate ID:**

**Start Time:** 0950
**Start Date:** 9/25/10
**Finish Time:** 1535
**Finish Date:** 9/25/10

**Depth to Groundwater:** 26.07 ft bgs 9/29/10
**Surface Elevation:** 5076.340

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| -5 | | | | | | |
| 0 | | SC | 20 | 80 | 0 | ***Clayey Sand*** Brown, fine to medium grained, moist (0-12ft) Loose (7-12ft) |
| 5 | | | | | | |
| 10 | | | | | | |
| 15 | | CL | 80 | 20 | 0 | ***Lean Clay with Sand*** Brown, medium plasticity, medium toughness, moist (12-20ft) |
| 20 | | | | | | Wet (20-25ft) |
| 25 | | CL | 65 | 35 | T | ***Sandy Lean Clay*** Medium plasticity, medium toughness, wet (25-39ft) |
| 30 | | | | | | |
| 35 | | | | | | |
| 40 | | SP | NM | NM | NM | ***Sand*** Brown, poorly graded, fine to medium grained, wet (39-43ft) |
| 45 | | Shale | | | | ***Weathered Shale*** Brown, fractured, iron staining, moist (43-49ft) Total Depth = 49ft |
| 50 | | | | | | |



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**Job No.:** 23445947
**Client:** Arizona Public Service
**Project:** Phase II - Seepage Study
**Location:** Four Corners Power Plant

**Driller:** Boart Longyear
**Drilling Method:** Rotosonic (SR121)
**Sampling Method:** Continuous Core/Grab Sampling
**Logged by:** Derrick Maurer

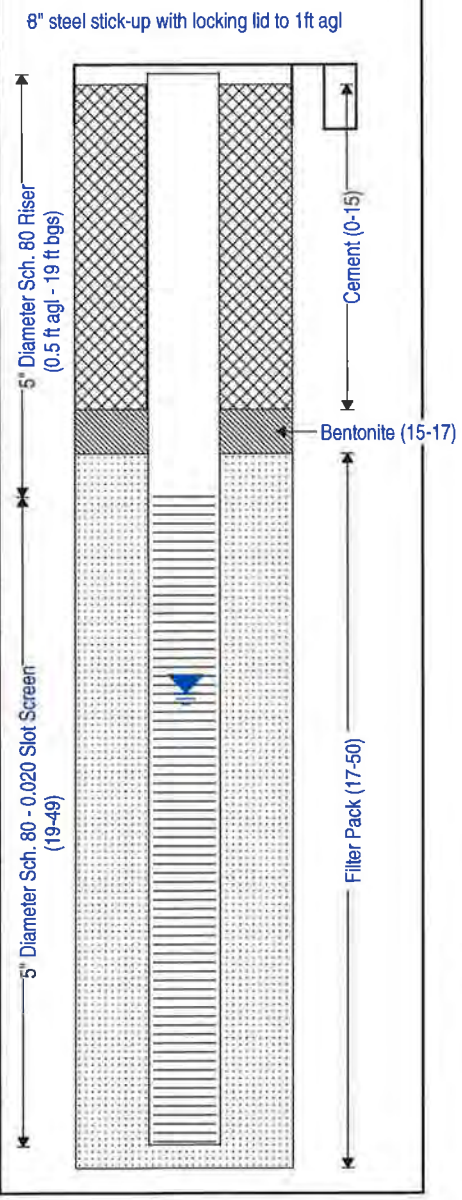
# Boring No. EW-15

**Alternate ID:**

**Start Time:** 1640
**Start Date:** 9/26/10
**Finish Time:** 1100
**Finish Date:** 9/27/10

**Depth to Groundwater:** 28.05 ft bgs 9/29/10
**Surface Elevation:** 5074.279

| Depth (ft) | Graphic Log | Lithology | Fines % | Sand % | Gravel % | Description |
|---|---|---|---|---|---|---|
| 0 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Brown, medium plasticity, medium toughness, moist (0-9ft) |
| 10 | | CL | 90 | 10 | 0 | ***Lean Clay*** Dark Brown, medium plasticity, medium toughness, moist (9-17ft) |
| 20 | | CL | 70 | 30 | 0 | ***Sandy Lean Clay*** Medium plasticity, medium toughness, moist (17-19ft) |
| | | CL | 90 | 10 | 0 | ***Lean Clay*** Medium plasticity, medium toughness, wet (19-23ft) |
| 25 | | SC | 40 | 60 | 0 | ***Clayey Sand*** Fine to medium grained, wet (23-25ft) |
| | | CL | 90 | 10 | 0 | ***Lean Clay*** Medium Plasticity, medium toughness, wet (25-36ft) |
| 40 | | SP | 95 | 5 | T | ***Sand*** Poorly graded, fine to medium grained, wet (36-47ft) |
| 50 | | CL | 90 | 10 | 0 | ***Lean Clay*** Brown and black, wet (47-50ft) Total Depth = 50ft |



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# Borehole: SB-11+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/28/2012 8:32:00 AM
**FINISH DATE/TIME:** 9/28/2012 10:54:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522013.701
**North:** 2070991.516
**TOP OF GROUND ELEVATION (NAVD88):** 5098.285 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | dry | 0.7 | | | CLAYEY SAND, (SC) brown, fine to medium grained, dry |
| 10 | | 0.7 | | | |
| 20 | | 0.3 | | 20.0 | |
| | moist | | | | WEATHERED SHALE, completely weathered, brown, moist |
| | | 1.0 | | | |
| | ▼ recovery =0.02 ft/min recovery = 0.125 ft/min | | | | |
| 30 | | 1.0 | | | |
| 40 | | | | 40.0 | |
| | dry | 1.0 | | | UNWEATHERED SHALE, blue gray, dry |
| | | | | 45.0 | |

Total Depth of borehole = 45.0 feet
Static Water Level = 27.7 ft bgs

URS

# Borehole: SB-12+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/28/2012 11:42:00 AM
**FINISH DATE/TIME:** 9/28/2012 1:35:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521928.202
**North:** 2070875.618
**TOP OF GROUND ELEVATION (NAVD88):** 5097.706 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | dry | 1.2 | | 13.0 | SANDY LEAN CLAY, (CL) brown, dry, medium plasticity, medium toughness |
| 10 | moist to wet | 2.5 | | 17.0 | POORLY GRADED SAND WITH GRAVEL, (SP) brown, fine to medium grained, gravel is subrounded to rounded mostly fine gravel, moist to wet at 16 ft bgs |
| | moist | 0.4 | | | WEATHERED SHALE, moist |
| 20 | | 1.0 | | | |
| | ▼ | | | | |
| 30 | | 1.0 | | | |
| 40 | | 1.0 | | 42.0 | |
| | dry | | | | UNWEATHERED SHALE, blue gray, dry |
| | | | | 48.0 | |

Total Depth of borehole = 48.0 feet
Static Water Level = 27.7 ft bgs

URS

# Borehole: SB-14+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/27/2012 11:30:00 AM
**FINISH DATE/TIME:** 9/27/2012 2:40:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521827.858
**North:** 2070696.405
**TOP OF GROUND ELEVATION (NAVD88):** 5091.524 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | 8.0 | SANDY LEAN CLAY, (CL) brown, dry, medium plasticity, medium toughness |
| 10 | moist 24 ft bgs possible water zone | 1.0 | | | WEATHERED SHALE, brown, dry |
| 20 | | 1.0 | | | |
| 30 | | 1.0 | | 39.0 | |
| 40 | 37-39 ft bgs mud/water dry | 1.0 | | 45.0 | UNWEATHERED SHALE, blue gray, dry |

Total Depth of borehole = 45.0 feet
wet/muddy water detected at approx. 44 ft bgs, but no water level was recorded. possible water zones include 37-39 ft bgs and approx. 24 ft bgs

URS

# Borehole: SB-16+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/27/2012 2:52:00 PM
**FINISH DATE/TIME:** 9/27/2012 4:00:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521708.051
**North:** 2070536.68
**TOP OF GROUND ELEVATION (NAVD88):** 5087.07 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | dry | 1.6 | | 8.0 | SANDY LEAN CLAY, (CL) brown, dry, medium plasticity, medium toughness |
| 10 | dry | 1.0 | | | WEATHERED SHALE, dry |
| | ▼ | | | | |
| 20 | moist | 1.0 | | | |
| 30 | 30-39 ft bgs possible water zone | 1.0 | | | |
| | | 1.0 | | 39.0 | |
| 40 | dry | | | 45.0 | UNWEATHERED SHALE, blue gray, dry |

Total Depth of borehole = 45.0 feet
Static Water Level = 27.7 ft bgs

Water zone approx. 30-39 ft bgs

URS

# Borehole: SB-17+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/28/2012 2:22:00 PM
**FINISH DATE/TIME:** 9/28/2012 3:57:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521728.44
**North:** 2070434.014
**TOP OF GROUND ELEVATION (NAVD88):** 5088.654 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 1.0 | | 8.0 | SANDY LEAN CLAY, (CL) brown, dry, medium plasticity, medium toughness |
| 10 | | 0.7 | | | WEATHERED SHALE, dry |
| | ▼ | | | | |
| 20 | moist | 1.0 | | | |
| 30 | | 1.0 | | 35.0 | |
| | | 1.0 | | 39.0 | WEATHERED/UNWEATHERED SHALE TRANSITION ZONE, cuttings change from weathered to unweathered shale several times |
| 40 | dry | | | 45.0 | UNWEATHERED SHALE, blue gray, dry |

Total Depth of borehole = 45.0 feet
Static Water Level = 15.30 ft bgs

URS

# Borehole: SB-19+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 9/29/2012 8:18:00 AM
**FINISH DATE/TIME:** 9/30/2012 8:45:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521776.761
**North:** 2070230.975
**TOP OF GROUND ELEVATION (NAVD88):** 5091.504 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | | WEATHERED SHALE, brown, dry |
| | moist | | | | |
| 10 | | 0.5 | | | |
| 20 | 22 to 32 water in the hole bevernight drilling depth of 32 ft bgs | | | | |
| 30 | | | | | Cuttings are saturated with water driller continue to add water and also have circulation loss into formation |
| 40 | | | | | could not get cutting recovery to identify weathered/unweathered contact |

Total Depth of borehole = 45.0 feet
Tag water at 41.45 ft bgs

URS

# Borehole: SB-21+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 9/30/2012 9:15:00 AM
**FINISH DATE/TIME:** 9/30/2012 10:50:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521813.166
**North:** 2070046.7
**TOP OF GROUND ELEVATION (NAVD88):** 5090.018 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.5 | | 5.0 | SANDY LEAN CLAY, brown, dry, medium plasticity, medium toughness |
| | dry | | | 7.0 | CLAYEY SAND WITH GRAVEL, brown, well rounded, fine to medium grained, dry |
| 10 | moist | 0.4 | | | WEATHERED SHALE, brown |
| | | 0.6 | | | |
| 20 | moist | | | | |
| | moist | 1.2 | | | |
| 30 | | | | | |
| | dry | | | 39.0 | |
| 40 | | | | | UNWEATHERED SHALE, blue |
| | | | | 45.0 | |

Total Depth of borehole = 45.0 feet
Backfill to 37 ft bgs with bentonite chips

URS

# Borehole: SB-23+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 9/30/2012 11:40:00 AM
**FINISH DATE/TIME:** 9/30/2012 1:00:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521831.251
**North:** 2069888.422
**TOP OF GROUND ELEVATION (NAVD88):** 5090.642 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.4 | | 10.0 | CLAYEY SAND, brown, fine to medium grained, dry |
| 10 | moist | 0.7 | | | WEATHERED SHALE, brown |
| | ▼ | | | | |
| | moist | | | | |
| 20 | | 1.0 | | | |
| | moist | | | | |
| | | 1.0 | | | |
| 30 | | | | | |
| | moist | | | | |
| | moist | 1.0 | | 39.0 | |
| 40 | | | | | WEATHERED/UNWEATHERED SHALE TRANSITION ZONE, blue brown |
| | dry | | | 43.0 | |
| | | | | | UNWEATHERED SHALE, blue gray |
| | | | | 48.0 | |

Total Depth of borehole = 48.0 feet
DTW = ND (tagged bottom at 47 ft bgs), backfill with bentonite chips to 35 ft bgs, Static water level = 16.50 ft bgs

URS

# Borehole: SB-25+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 9/30/2012 2:05:00 PM
**FINISH DATE/TIME:** 9/30/2012 3:21:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521892.337
**North:** 2069648.361
**TOP OF GROUND ELEVATION (NAVD88):** 5091.192 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry<br>moist | 0.9 | | | CLAYEY SAND, brown, fine to medium grained |
| | | 0.5 | | 8.0 | |
| 10 | | | | 10.0 | POORLY GRADED SAND, well rounded, coarse grained |
| | moist | | | | WEATHERED SHALE, brown, interbedded sandstone, chert, trace gypsum, and iron oxide staining |
| | moist | 0.5 | | 13.0 | |
| | ▼ | | | | WEATHERED SHALE, brown |
| 20 | moist | 0.5 | | | |
| | moist | | | | |
| | | 1.2 | | | |
| 30 | moist | | | | |
| | | 1.2 | | | |
| 40 | dry | 1.2 | | 40.0 | |
| | | | | 45.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 45.0 feet
DTW = ND, mud on end of probe, backfill to 35 ft bgs with bentonite chips, static water level = 16.00 ft bgs

URS

# Borehole: SB-27+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/1/2012 8:50:00 AM
**FINISH DATE/TIME:** 10/1/2012 10:40:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521915.591
**North:** 2069511.338
**TOP OF GROUND ELEVATION (NAVD88):** 5094.192 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | moist | 0.3 | | 13.0 | |
| | | | | | WEATHERED SHALE, brown |
| 20 | dry | | | | |
| 30 | dry | | | | |
| | moist | 0.7 | | | |
| 40 | | 1.2 | | 38.0 | |
| | moist | | | | WEATHERED/UNWEATHERED SHALE TRANSITION ZONE, brown blue |
| | | | | 44.0 | |
| 50 | | | | | UNWEATHERED SHALE, blue gray |
| | | | | 50.0 | |

Total Depth of borehole = 50.0 feet
DTW = ND ( no mud), backfill to 23 ft bgs cave in to 25 ft bgs

# URS

## Borehole: SB-28+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/1/2012 11:45:00 AM
**FINISH DATE/TIME:** 10/1/2012 1:05:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521938.364
**North:** 2069406.566
**TOP OF GROUND ELEVATION (NAVD88):** 5095.344 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | dry | 0.7 | | 8.0 | SANDY LEAN CLAY WITH GRAVEL, brown, subangular to subrounded |
| 10 | | | | 12.0 | CLAYEY SAND, brown, shale fragments |
| | dry | 0.9 | | 20.0 | SANDY LEAN CLAY, brown, subangular to subrounded |
| 20 | | | | 24.0 | CLAYEY SAND WITH GRAVEL, brown, fine to coarse grained, sandstone fragments |
| | moist | 0.6 | | | WEATHERED SHALE, brown |
| | moist | | | | |
| 30 | | 1.0 | | | |
| | dry | | | 38.0 | |
| 40 | | | | | UNWEATHERED SHALE, blue gray |
| | | | | 43.0 | |

Total Depth of borehole = 43.0 feet
DTW = ND, mud from 41 to 43 ft bgs, backfill to 35.5 ft bgs with bentonite chips

URS

# Borehole: SB-30+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/2/2012 8:00:00 AM
**FINISH DATE/TIME:** 10/2/2012 9:17:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2521977.148
**North:** 2069197.62
**TOP OF GROUND ELEVATION (NAVD88):** 5095.089 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | | | 5.0 | SANDY LEAN CLAY, (CL) brown, medium plasticity, medium toughness |
| 10 | dry | | | | WEATHERED SHALE, brown |
| 20 | moist | | | | |
| 30 | ▼ moist | | | | |
| 40 | moist | | | | |
| | dry | | | 41.0 | |
| | | | | 47.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 47.0 feet
DTW = ND mud on end of probe, backfill to 37 ft by

URS

# Borehole: SB-32+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/2/2012 10:00:00 AM
**FINISH DATE/TIME:** 10/2/2012 11:20:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522028.187
**North:** 2068961.01
**TOP OF GROUND ELEVATION (NAVD88):** 5094.564 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.4 | | | CLAYEY SAND, (SC) brown, subrounded, fine to coarse grained |
| 10 | dry | 0.5 | | 13.0 | WEATHERED SHALE, brown |
| 20 | moist | | | | |
| 30 | moist | 1.0 | | | |
| | dry | | | 36.0 | UNWEATHERED SHALE, blue gray |
| 40 | | | | 41.0 | |

Total Depth of borehole = 41.0 feet
DTW = ND (mud on bottom of 1.5 inches of probe, backfill to 31 ft bgs with bentonite chips

# URS

## Borehole: SB-34+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/2/2012 12:45:00 PM
**FINISH DATE/TIME:** 10/2/2012 1:50:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522071.55
**North:** 2068766.982
**TOP OF GROUND ELEVATION (NAVD88):** 5094.649 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | | SANDY LEAN CLAY, brown, medium plasticity, medium toughness |
| | moist | | | | |
| 10 | moist | | | 15.0 | |
| | moist | | | 18.0 | CLAYEY SAND, brown, fine to medium grained, pieces of broken sandstone |
| 20 | ▼ | 1.0 | | | WEATHERED SHALE, brown |
| 30 | moist | | | 37.0 | |
| | dry | 1.0 | | | WEATHERED/UNWEATHERED SHALE TRANSITION ZONE, brown blue |
| 40 | dry | | | 40.0 | UNWEATHERED SHALE, blue gray |
| | | | | 45.0 | |

Total Depth of borehole = 45.0 feet
DTW = ND tape wet from 28 to 29 ft bg, backfill to 35.5 ft bgs with bentonite chips, static water level = 19.32 ft bgs

URS

# Borehole: SB-38+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/2/2012 2:38:00 PM
**FINISH DATE/TIME:** 10/2/2012 3:50:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522135.217
**North:** 2068431.799
**TOP OF GROUND ELEVATION (NAVD88):** 5092.789 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | | SANDY LEAN CLAY, (CL) brown, medium plasticity, medium toughness |
| 10 | dry | | | 10.0 | |
| | moist | 0.7 | | | WEATHERED SHALE, brown |
| 20 | moist | 0.7 | | | |
| | | 1.0 | | | |
| 30 | moist | | | | |
| | dry | | | 38.0 | |
| 40 | | | | | UNWEATHERED SHALE, blue gray |
| | | | | 42.0 | |

Total Depth of borehole = 42.0 feet
DTW = ND (mud on tape from 21 to 26 ft bgs, backfill to 33.5 ft bgs with bentonite chips

# URS

# Borehole: SB-42+30

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/3/2012 7:50:00 AM
**FINISH DATE/TIME:** 10/3/2012 11:40:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522212.363
**North:** 2068008.416
**TOP OF GROUND ELEVATION (NAVD88):** 5091.092 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | moist | 0.1 | | | SANDY LEAN CLAY, brown, medium plasticity, medium toughness |
| 10 | dry | | | 11.0 | |
| | moist | | | | WEATHERED SHALE, brown, (possible alluvium) cuttings poor and poor recovery |
| 20 | wet - water coming out of borehole | 0.7 | | | (23-32) cuttings poor, mostly water |
| 30 | moist | 1.0 | | | |
| 40 | dry | | | 45.0 | |
| 50 | | | | 51.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 51.0 feet
DTW = 20.5 ft bgs, Saturated zone = 23 to 30 ft bgs, static water level = 17.00 ft bgs

URS

# Borehole: SB-44+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/4/2012 7:35:00 AM
**FINISH DATE/TIME:** 10/4/2012 12:40:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522264.719
**North:** 2067801.233
**TOP OF GROUND ELEVATION (NAVD88):** 5088.044 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | moist | 1.2 | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | moist | | | | |
| 20 | wet | | | | |
| | wet | 0.9 | | 27.0 | |
| 30 | moist | | | 30.0 | WELL GRADED SAND WITH GRAVEL, fine to coarse grained, fragments of sandstone, some clay |
| | | 0.7 | | | WEATHERED SHALE, brown |
| 40 | dry | | | 42.0 | |
| | | | | 47.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 47.0 feet
DTW = ND tape muddy from 36 to 47 ft bgs, backfill to 37.4 ft bgs with bentonite chips

URS

# Borehole: SB-46+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Morgan Wagoner
**START DATE/TIME:** 10/4/2012 1:52:00 PM
**FINISH DATE/TIME:** 10/4/2012 3:15:30 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522287.777
**North:** 2067639.265
**TOP OF GROUND ELEVATION (NAVD88):** 5088.635 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | moist | 1.1 | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | moist | | | | |
| | ▽ | | | 17.0 | |
| | | | | | WEATHERED SHALE, brown |
| 20 | dry | 0.7 | | | |
| 30 | dry | | | | |
| | moist | 0.7 | | | |
| | wet | | | | |
| 40 | wet | | | 40.0 | |
| | dry | | | | UNWEATHERED SHALE, blue gray |
| | | | | 45.0 | |

Total Depth of borehole = 45.0 feet
DTW = 17.5 ft bgs, backfill to 38 ft bgs with bentonite chips, static water level = 17.275 ft bgs

URS

# Borehole: SB-47+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/4/2012 4:20:00 PM
**FINISH DATE/TIME:** 10/5/2012 8:06:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522305.977
**North:** 2067541.382
**TOP OF GROUND ELEVATION (NAVD88):** 5089.348 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 0.7 | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | moist | 0.5 | | 12.0 | WEATHERED SHALE, brown |
| 20 | | | | | |
| 30 | moist<br>wet | | | | |
| | dry | 0.33 | | 35.0 | UNWEATHERED SHALE, blue gray |
| 40 | | | | 40.0 | |

Total Depth of borehole = 45.0 feet
DTW = ND, backfill to 32.5 ft bgs with bentonite chips

URS

# Borehole: SB-48+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/5/2012 9:12:00 AM
**FINISH DATE/TIME:** 10/5/2012 10:52:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522320.734
**North:** 2067443.937
**TOP OF GROUND ELEVATION (NAVD88):** 5087.052 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | moist | 0.4 | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | driller adding water at 14 ft bgs | | | | |
| 20 | moist dry Stop adding water at 21 ft bgs | 0.25 | | 20.0 | WEATHERED SHALE, brown |
| 30 | dry | | | | |
| | dry | | | 34.0 | UNWEATHERED SHALE, blue gray |
| 40 | | 0.33 | | 40.0 | |

Total Depth of borehole = 40.0 feet
DTW = ND, backfill to 31 ft bgs with bentonite chips

URS

# Borehole: SB-48+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/5/2012 11:52:00 AM
**FINISH DATE/TIME:** 10/5/2012 12:52:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522314.892
**North:** 2067386.156
**TOP OF GROUND ELEVATION (NAVD88):** 5089.21 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | | | | CLAYEY SAND, brown, fine to medium grained |
| 10 | moist | | | | |
| | moist | | | 14.0 | |
| | | | | | WEATHERED SHALE, brown |
| | | 0.53 | | | |
| 20 | | | | | |
| | | 0.8 | | | |
| 30 | moist | | | | |
| | | 0.75 | | 33.0 | |
| | dry | 0.75 | | 35.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 35.0 feet
DTW = ND, not mud on probe, backfill to 31' bgs with bentonite chips

URS

# Borehole: SB-51+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/5/2012 2:08:00 PM
**FINISH DATE/TIME:** 10/5/2012 3:03:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522316.914
**North:** 2067097.827
**TOP OF GROUND ELEVATION (NAVD88):** 5091.97 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | | | | 3.0 | CLAYEY SAND, brown, fine to medium grained |
| | | | | 4.0 | SANDSTONE |
| | | 0.5 | | | WEATHERED SHALE, brown |
| 10 | dry | | | | |
| | moist | | | | |
| 20 | | | | | |
| | moist | 1.7 | | | |
| 30 | | | | | |
| | moist | | | | |
| | wet | 0.9 | | 35.0 | |
| | dry | | | | UNWEATHERED SHALE, blue gray |
| | | | | 37.0 | |

Total Depth of borehole = 37.0 feet
DTW = 33.3, backfill to 34 ft bgs with bentonite chips, static water level on 10-6-12 = no water TD was 17.7 ft bgs possible bridging

# URS

## Borehole: SB-53+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/6/2012 7:53:00 AM
**FINISH DATE/TIME:** 10/6/2012 8:40:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522305.543
**North:** 2066873.537
**TOP OF GROUND ELEVATION (NAVD88):** 5095.323 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 1.8 | | 8.0 | CLAYEY SAND, brown, fine to medium grained |
| 10 | dry | | | 10.0 | POORLY GRADED SAND, well rounded, coarse grained |
| | dry | | | | WEATHERED SHALE, brown |
| 20 | moist | 1.8 | | | |
| | | 3.4 | | | |
| 30 | moist | | | 36.0 | |
| | dry | 2.1 | | | UNWEATHERED SHALE, blue gray |
| 40 | | | | 41.0 | |

Total Depth of borehole = 41.0 feet
DTW = ND, dry probe, backfill to 32 ft bgs with bentonite chips

# URS

## Borehole: SB-55+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/5/2012 3:48:00 PM
**FINISH DATE/TIME:** 10/5/2012 4:33:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522311.131
**North:** 2066700.646
**TOP OF GROUND ELEVATION (NAVD88):** 5095.669 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 5.2 | | 3.0 | CLAYEY SAND, fine to medium grained |
| | dry | 5.2 | | 4.0 | POORLY GRADED SAND WITH GRAVEL, coarse grained |
| | | 0.8 | | | CLAYEY SAND, fine to medium grained |
| 10 | dry | | | | |
| | moist | | | 14.0 | |
| | | 0.28 | | | WEATHERED SHALE |
| 20 | | | | | |
| 30 | | | | | |
| | moist | | | 35.0 | |
| | dry | | | | UNWEATHERED SHALE, blue gray |
| | | | | 38.0 | |

Total Depth of borehole = 38.0 feet
DTW = ND, dry probe, backfill to 34 ft bgs with bentonite chips

URS

# Borehole: SB-57+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/6/2012 10:56:00 AM
**FINISH DATE/TIME:** 10/6/2012 11:55:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522316.455
**North:** 2066489.949
**TOP OF GROUND ELEVATION (NAVD88):** 5096.194 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 2.15 | | | CLAYEY SAND, fine to medium grained, some well rounded gravel up to 1/2" diam. |
| | dry | | | | |
| 10 | | 0.8 | | 10.0 | |
| | | | | | SANDSTONE, some gypsum and well rounded gravel |
| | dry | | | 15.0 | |
| | | | | | WEATHERED SHALE |
| 20 | | 2.12 | | | |
| | ▼ | | | | |
| 30 | dry moist | | | | |
| | | 1.97 | | 36.0 | |
| | dry | 1.4 | | | UNWEATHERED SHALE, blue gray |
| 40 | | | | 41.0 | |

Total Depth of borehole = 41.0 feet
DTW = ND, dry probe, backfill to 31 ft bgs with bentonite chips, static water level = 25.2 ft bgs

URS

# Borehole: SB-59+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/6/2012 12:30:00 PM
**FINISH DATE/TIME:** 10/6/2012 1:21:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522311.037
**North:** 2066293.735
**TOP OF GROUND ELEVATION (NAVD88):** 5094.514 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 1.76 | | | CLAYEY SAND, fine to medium grained |
| 10 | | | | 11.0 | |
| | dry moist | 1.1 | | | WEATHERED SHALE |
| 20 | | | | | |
| | | 1.67 | | | |
| 30 | | | | | |
| | moist | | | | |
| 40 | | | | 40.0 | |
| | dry | 1.6 | | | UNWEATHERED SHALE, blue gray |
| | | | | 45.0 | |

Total Depth of borehole = 45.0 feet
DTW = ND, dry probe, backfill to 36.1 ft bgs with bentonite chips

URS

# Borehole: SB-61+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/6/2012 2:06:00 PM
**FINISH DATE/TIME:** 10/6/2012 3:05:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522316.325
**North:** 2066140.567
**TOP OF GROUND ELEVATION (NAVD88):** 5093.626 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | dry | 1.3 | | | CLAYEY SAND, fine to medium grained |
| 10 | | | | 10.0 | |
| | dry<br>moist | 1.43 | | | WEATHERED SHALE |
| 20 | | | | | |
| | | 1.85 | | | |
| 30 | | | | | |
| | moist | | | | |
| 40 | | | | | |
| | moist | | | | |
| | dry | | | 47.0 | UNWEATHERED SHALE, blue gray |
| 50 | | | | 51.0 | |

Total Depth of borehole = 51.0 feet
DTW = ND, dry probe, backfill to 34.1 ft bgs with bentonite chips, static water level = ND - dry at 31.9 ft bgs

URS

# Borehole: SB-63+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/6/2012 3:50:00 PM
**FINISH DATE/TIME:** 10/7/2012 8:59:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522317.138
**North:** 2065945.004
**TOP OF GROUND ELEVATION (NAVD88):** 5093.66 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 1.25 | | | CLAYEY SAND, fine to medium grained |
| | dry | | | 5.0 | WEATHERED SHALE |
| 10 | | | | | |
| | dry | | | | |
| 20 | | 1.28 | | 27.0 | |
| | dry | | | | Possible large gypsum deposite or gravelly concretous material with quartz and reddish angular rock |
| 30 | moist | | | 30.0 | WEATHERED SHALE |
| | | 2.15 | | | |
| | ▼ | | | | |
| 40 | | | | | |
| | moist | | | | |
| 50 | | | | 50.0 | |
| | dry | 1.3 | | 53.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 53.0 feet
DTW = ND, dry probe, backfill to 41.8 ft bgs with bentonite chips, static water level = 36.1 ft bgs

# URS

# Borehole: SB-66+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/7/2012 12:33:00 PM
**FINISH DATE/TIME:** 10/7/2012 1:15:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522313.764
**North:** 5065633.714
**TOP OF GROUND ELEVATION (NAVD88):** 5094.071 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 2.1 | | 7.0 | CLAYEY SAND, fine to medium grained, some cobbles, well rounded, ranging in size to 1/2" diam. |
| 10 | | | | 12.0 | SILTY SAND, fine grained |
| 20 | dry<br>moist | 2.5 | | | WEATHERED SHALE |
| 30 | | 2.17 | | | |
| 40 | moist<br>dry | | | 35.0<br>40.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 40.0 feet
DTW = ND, dry probe, backfill to 30.1 ft bgs with bentonite chips

# URS

## Borehole: SB-68+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/7/2012 1:43:00 PM
**FINISH DATE/TIME:** 10/7/2012 2:20:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522314.179
**North:** 2065377.253
**TOP OF GROUND ELEVATION (NAVD88):** 5093.095 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | | | 8.0 | SILTY SAND, fine grained |
| 10 | dry | | | 12.0 | CLAYEY SAND, fine to medium grained, some well rounded cobbles to 1/2" diam. |
| 20 | | 2.9 | | 37.0 | WEATHERED SHALE |
| 30 | dry moist ▽ | | | | |
| 40 | dry | 2.0 | | 42.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 42.0 feet
DTW = ND, dry probe, backfill to 32.4 ft bgs with bentonite chips, static water level = 31.4

# URS

## Borehole: SB-71+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/7/2012 2:57:00 PM
**FINISH DATE/TIME:** 10/7/2012 3:40:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522315.175
**North:** 2065131.955
**TOP OF GROUND ELEVATION (NAVD88):** 5093.499 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | | | 8.0 | CLAYEY SAND, fine to medium grained, some well rounded and angular cobbles<br>(5-8) clayey sand with some sandstone |
| 10 | | | | 10.0 | SANDSTONE |
| | dry<br>moist | 1.67 | | 32.0 | WEATHERED SHALE |
| 30 | dry | 1.17 | | 37.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 37.0 feet
DTW = ND, dry probe, backfill to 28.4 ft bgs with bentonite chips

# URS

## Borehole: SB-73+50

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/7/2012 4:18:00 PM
**FINISH DATE/TIME:** 10/7/2012 4:57:00 PM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522315.184
**North:** 2064893.45
**TOP OF GROUND ELEVATION (NAVD88):** 5094.396 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 2.0 | | 7.0 | CLAYEY SAND, fine to medium grained |
| 10 | dry | 3.3 | | | WEATHERED SHALE |
| 20 | | 1.5 | | | |
| 30 | dry | | | 34.0 | |
| 40 | dry | | | 40.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 40.0 feet
DTW = ND, dry probe, backfill to 30 ft bgs with bentonite chips

# URS

## Borehole: SB-76+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/8/2012 8:16:00 AM
**FINISH DATE/TIME:** 10/8/2012 8:57:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522314.874
**North:** 2064639.98
**TOP OF GROUND ELEVATION (NAVD88):** 5097.048 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | dry | 2.1 | | | CLAYEY SAND, fine to medium grained |
| 10 | dry | 1.8 | | 14.0 | (11-14) some angular cobbles and sandstone |
| 20 | dry | 2.83 | | | WEATHERED SHALE |
| 30 | moist | | | | |
| | moist | | | 36.0 | |
| 40 | dry | 1.26 | | 41.0 | UNWEATHERED SHALE, blue gray |

Total Depth of borehole = 41.0 feet
DTW = ND, dry probe, backfill to 30.1 ft bgs with bentonite chips, static water level = ND - dry at 28.9 ft bgs

URS

# Borehole: SB-78+00

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Air Rotary with ODEX
**LOGGED BY:** Adam Ford
**START DATE/TIME:** 10/8/2012 9:46:00 AM
**FINISH DATE/TIME:** 10/8/2012 10:34:00 AM

**COMMENTS:** Elevations surveyed by Souder, Miller and Associates on 10/05/2012

**COORDINATES(NAD83): East:** 2522312.523
**North:** 2064309.479
**TOP OF GROUND ELEVATION (NAVD88):** 5105.286 feet A.S.L.

| DEPTH (ft) | MOISTURE CONTENT | Drilling Rate (ft/min) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | | |
| | | | | | CLAYEY SAND, fine to medium grained |
| 10 | dry | 1.67 | | 10.0 | |
| | | | | | POORLY GRADED SAND, coarse grained, well rounded cobbles up to 1" diam. |
| | | 1.16 | | 15.0 | |
| | | 2.6 | | | WEATHERED SHALE |
| 20 | dry moist | | | | |
| 30 | | | | | |
| | moist dry | | | 36.0 | |
| | | | | | UNWEATHERED SHALE, blue gray |
| 40 | | | | 41.0 | |

Total Depth of borehole = 41.0 feet
DTW = ND, dry probe, backfill to 31 ft bgs with bentonite chips

URS
7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-12R

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/26/2012 2:53:00 PM
**FINISH DATE/TIME:** 3/27/2012 1:20:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012 PVC and steel casing were extended ten feet on 4/23/12

**COORDINATES (NAD83):**
**North:** 2068356.17
**East:** 2527509.566
**TOP OF GROUND ELEVATION (NAVD88):** 5261.71feet A.S.L.

| DEPTH (ft) | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|
| 0 | | Sand, gray (7.5YR 5/1), fine to medium grain, dry, trace gravels and soft ash | Cement Grout (0-8 ft bgs) |
| | 8.0 | | |
| | 8.5 | Clay, wet | 4.5 inch diameter sch. 80 pvc riser (0-13.5 ft bgs) |
| 10 | | Weathered Shale, brown (7.5YR 4/4), dry, completely weathered, iron oxide staining | Bentonite Seal (8-13 ft bgs) |
| 20 | | | Filter Pack (10-20 Silica Sand) (13-34 ft bgs) |
| | | DTW = ND | 4.5 inch diameter sch. 80 PVC 0.020 slot screen (13.5-33.5 ft bgs) |
| | | DTW = ND (1 hour) | |
| 30 | | Visible water 30-34 ft bgs wet in fractures | |
| | 34.0 | | |
| | 35.0 | DTW = ND (mud on probe and sounder tape up to 31 ft bgs waited overnight) | |
| | | Limestone, greenish gray (10B 6/1), fine, completely weathered, iron oxide staining | |
| | | Weathered Shale, brown (7.5YR 4/4), dry, completely weathered, iron oxide staining | |
| 40 | | | |
| 50 | | | Bentonite Chips (34-70 ft bgs) |
| 60 | | | |
| | | Transition from weathered shale to unweathered shale | |
| | 63.0 | | |
| | | Unweathered Shale, blueish gray (10B 6/1), dry, hard, fine, unweathered | |

URS

7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-12R

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/26/2012 2:53:00 PM
**FINISH DATE/TIME:** 3/27/2012 1:20:00 PM

| DEPTH (ft) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|---|
| 70 | | 70.0 | Unweathered Shale, blueish gray (10B 6/1), dry, hard, fine, unweathered *(continued)* | |

Total Depth of borehole = 70.0 feet

URS
7720 North 16th Street STE 100
Phoenix, AZ



# Borehole: MW-40

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/25/2012 8:20:00 AM
**FINISH DATE/TIME:** 3/25/2012 1:50:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012

**COORDINATES (NAD83):**
**North:** 2069609.076
**East:** 2523640.187
**TOP OF GROUND ELEVATION (NAVD88):** 5134.91feet A.S.L.

| DEPTH (ft) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|---|
| 0 | | | Weathered Shale, brown (7.5YR 5/4), dry, completely weathered, gypsum | Cement Grout (0-6 ft bgs) |
| | | | | 4.5 inch diameter sch. 80 pvc riser (0-12.5 ft bgs) |
| 10 | | | | Bentonite Seal (6-11 ft bgs) |
| | | | | Filter Pack (10-20 Silica Sand) (11-23 ft bgs) |
| 20 | | | Damp to wet. No visible water in core. Driller noticed wet spot on core barrel at approximately 19-20 ft. bgs | 4.5 inch diameter sch. 80 PVC 0.020 slot screen (12.5-22.5 ft bgs) |
| | | 23.0 | | |
| | | | Unweathered Shale, blueish grey (10B 5/1), dry, hard, laminated, unweathered, fossils/shells observed in laminations | |
| | | | DTW = ND (2 hours) | |
| 30 | | | | |
| | | | | Bentonite Chips (23-50 ft bgs) |
| 40 | | | | |
| 50 | | 50.0 | DTW = ND (30 minutes) | |

Total Depth of borehole = 50.0 feet

URS

7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-41

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/25/2012 4:37:00 PM
**FINISH DATE/TIME:** 3/26/2012 12:20:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012

**COORDINATES (NAD83):**
**North:** 2071279.193
**East:** 2527525.246
**TOP OF GROUND ELEVATION (NAVD88):** 5253.98feet A.S.L.

| DEPTH (ft) | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|
| 0 | 2.0 | Ash, gray (7.5YR 6/1), dry, loose sand and silt | Cement Grout (0-14 ft bgs) |
| | | Weathered Shale, brown (7.5YR 4/4), dry, completely weathered, gypsum, iron oxide staining | |
| | | Moist | |
| 10 | | Wet, no visible water in fractures | 4.5 inch diameter sch. 80 pvc riser (0-20.2 ft bgs) |
| | | | Bentonite Seal (14-19 ft bgs) |
| | | DTW = ND (overnight) | |
| 20 | | | Filter Pack (10-20 Silica Sand) (19-36 ft bgs) |
| | | visible water in fractures at 26' (about 0.5 inches thick)<br>DTW = ND (35 minutes)<br>Visible water at 28 ft bgs | 4.5 inch diameter sch. 80 PVC 0.020 slot screen (20.2-35.2 ft bgs) |
| 30 | | DTW = ND (1 hour) mud/water on tape at 27 ft to 28 ft bgs, but no water coming into hole | |
| | 36.0 | | |
| | | Unweathered Shale, blueish gray (10B 5/1), dry, hard, unweathered, laminated, fractures in sheets<br>DTW = 37.26 ft bgs (0.02 GPM after 1 hour) | |
| 40 | | | Bentonite Chips (36-50 ft bgs) |
| 50 | 50.0 | | |

Total Depth of borehole = 50.0 feet

URS

7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-42

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/22/2012 10:15:00 AM
**FINISH DATE/TIME:** 3/23/2012 2:45:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012

**COORDINATES (NAD83):**
**North:** 2072910.359
**East:** 2526527.6
**TOP OF GROUND ELEVATION (NAVD88):** 5222.32feet A.S.L.

| DEPTH (ft) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|---|
| 0 | | | Weathered Shale, brown (5YR 4/4), damp, completely weathered, gypsum, iron oxide staining | Cement Grout (0-16 ft bgs) |
| 10 | | | Gypsum, iron oxide staining | 4.5 inch diameter schedule 80 pvc riser (0-22 ft bgs) |
| 20 | | | | Bentonite Seal (16-21 ft bgs) |
| | | | Wet | Filter Pack (10-20 Silica Sand) (21-38 ft bgs) |
| | | | DTW=ND (40 minutes) | |
| 30 | | | | 4.5 inch diameter sch. 80 PVC 0.020 slot screen (22-37 ft bgs) |
| | | | ompetent rock, damp, no visible water, DTW = ND | |
| | | 38.0 | | |
| 40 | | | Unweathered Shale, blueish gray (10B 5/1), dry, unweathered | |
| | | | DTW = ND | |
| 50 | | | | Bentonite Chips (38-72 ft bgs) |
| 60 | | | DTW = ND (overnight) | |

URS
7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-42

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/22/2012 10:15:00 AM
**FINISH DATE/TIME:** 3/23/2012 2:45:00 PM

| DEPTH (ft) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|---|
| 70 | | | Unweathered Shale, blueish gray (10B 5/1), dry, unweathered *(continued)* | |
| | | 72.0 | DTW = ND | |

Total Depth of borehole = 72.0 feet

URS

7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-43

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/23/2012 4:50:00 PM
**FINISH DATE/TIME:** 3/24/2012 12:05:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012

**COORDINATES (NAD83):**
**North:** 2072045.99
**East:** 2530655.841
**TOP OF GROUND ELEVATION (NAVD88):** 5269.42feet A.S.L.

| DEPTH (ft) | GRAPHIC LOG | Lithology Depth | MATERIAL DESCRIPTION | WELL INFORMATION |
|---|---|---|---|---|
| 0 | | | Weathered Shale, brown (7.5YR 5/4), dry, completely weathered | Cement Grout (0-10 ft bgs) |
| 10 | | | Caliche, light brown (7.5YR 6/3), dry, hard, gypsum<br>Weathered Shale, brown (7.5YR 5/4), dry, completely weathered | 4.5 inch diameter sch. 80 pvc riser (0-16 ft bgs)<br>Bentonite Seal (10-15.5 ft bgs) |
| 20 | | | Caliche, gray (7.5YR 6/1), dry, hard<br>Weathered Shale<br>Damp<br>DTW = ND (overnight) | Filter Pack (10-20 Silica Sand) (15.5-27 ft bgs)<br>4.5 inch diameter sch. 80 PVC 0.020 slot screen (16-26 ft bgs) |
| | | 27.0 | | |
| 30 | | | Unweathered Shale, blueish gray (10B 5/1), damp, hard, laminated<br>DTW = ND | |
| 40 | | | DTW = ND (35 minutes) | Bentonite Chips (27-60 ft bgs) |
| 50 | | | | |
| 60 | | 60.0 | DTW = ND (1.5 hours) | |

Total Depth of borehole = 60.0 feet

URS

7720 North 16th Street STE 100
Phoenix, AZ

# Borehole: MW-44

**PROJECT:** Four Corners Power Plant
**CLIENT:** APS
**LOCATION:** Fruitland, NM
**URS PROJECT #:** 23446275

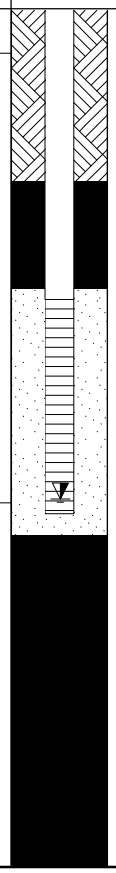
**DRILLING METHOD:** Rotosonic
**LOGGED BY:** Derrick Maurer
**START DATE/TIME:** 3/27/2012 4:20:00 PM
**FINISH DATE/TIME:** 3/28/2012 1:00:00 PM

**COMMENTS:** Surveyed by Souder, Miller and Associates: June 2012

**COORDINATES (NAD83):**
**North:** 2065826.301
**East:** 2525157.767
**TOP OF GROUND ELEVATION (NAVD88):** 5145.15feet A.S.L.

| DEPTH (ft) | Lithology Depth | MATERIAL DESCRIPTION |
|---|---|---|
| 0 | 2.0 | (SM) Silty Sand, brown, fine grain, dry, some gravel |
| | | Weathered Shale, brown, damp, completely weathered, gypsum, iron oxide staining |
| 10 | | DTW = ND (overnight) |
| 20 | 23.0 | Unweathered Shale, blueish gray (10B 5/1), dry, hard, unweathered, laminated, sheet fractures, small fossils |
| 30 | | DTW = ND (30 minutes)<br>DTW = ND (1 hour) |
| 40 | 40.0 | DTW = ND |

Total Depth of borehole = 40.0 feet



WELL INFORMATION

- Cement Grout (0-8 ft bgs)
- 4.5 inch diameter sch. 80 pvc riser (0-13.5 ft bgs)
- Bentonite Seal (8-13 ft bgs)
- Filter Pack (10-20 Silica Sand) (13-24.5 ft bgs)
- 4.5 inch diameter sch. 80 PVC 0.020 slot screen (13.5-23.5 ft bgs)
- Bentonite Chips (24.5-40 ft bgs)